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ICONIC SIGNS AND SYMBOLS IN AUDIOVISUAL COMMUNICATION, AN ANALYTICAL SURVEY OF SELECTED WRITINGS AND RESEARCH FINDINGS. FINAL REPORT.

BY- NORBERG, KENNETH D.
SACRAMENTO STATE COLL., CALIF.

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THE FIELD OF ANALOGIC, OR ICONIC, SIGNS WAS EXPLORED TO (1) DEVELOP AN ANNOTATED BIBLIOGRAPHY AND (2) PREPARE AN ANALYSIS OF THE SUBJECT AREA. THE SCOPE OF THE STUDY WAS LIMITED TO ONLY THOSE COMPONENTS OF MESSAGES, INSTRUCTIONAL MATERIALS, AND COMMUNICATIVE STIMULI THAT CAN BE DESCRIBED PROPERLY AS ICONIC. THE AUTHOR BASED THE STUDY ON A DEFINITION OF AN ICONIC SIGN AS ONE THAT LOOKS LIKE THE THING IT REPRESENTS. THE BIBLIOGRAPHY WAS INTENDED TO BE REPRESENTATIVE AND REASONABLY COMPREHENSIVE AND TO GIVE EMPHASIS TO CURRENT RESEARCH. THE ANALYSIS EXPLORED THE NATURE OF ICONIC SIGNS AS REFLECTED IN THE LITERATURE AND RESEARCH. THE CONCLUSION OF THE ANALYSIS ATTEMPTED TO RELATE SOME ISSUES IN PERCEPTION THEORY TO THE PROBLEM OF THE DEVELOPMENT OF A THEORY OF ICONIC SIGNS. DISCUSSIONS WERE INCLUDED ON (1) THE STIMULUS-RESPONSE PARADIGM, (2) THE PSYCHOPHYSICAL THEORY OF PERCEPTION, (3) AN INFORMATION THEORY APPROACH, (4) NONVERBAL COMMUNICATION AND PICTIC ANALYSIS, (5) A THEORY OF PICTORIAL COMMUNICATION, AND (6) PERCEPTION AND NONLINEAR SIGNS. (AL)

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THE NATURE AND FUNCTIONS OF ANALOGICAL SIGNS AND SYMBOLS

Kenneth D. Norberg

U. S. Department of Health, Education and Welfare

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ICONIC SIGNS AND SYMBOLS IN AUDIOVISUAL COMMUNICATION

An Analytical Survey of Selected Writings and Research Findings

Kenneth D. Norberg: Principal Investigator
Sacramento State College

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TABLE OF CONTENTS

Page

Purpose and Scope of the Study 1

Iconic Signs and Realism in Instructional Materials 6

The Stimulus-Response Paradigm 13

The Psychophysical Theory of Perception 18

An Information Theory Approach 23

Nonverbal Communication and "Pictic Analysis" 29

A Theory of Pictorial Communication 30

Perception and Non-Linear Signs 36

Additional Comments and Conclusion 42

Annotated Bibliography 46

PURPOSE AND SCOPE OF THE STUDY

This study of the literature dealing with iconic[*] signs (and symbols)[**] was undertaken with two major goals in view: (a) to explore the field and develop an annotated bibliography, and (b) to prepare an analysis which might be useful to others who wish to examine the literature, or to conduct research in this area. In the original statement of project objectives the author expressed the hope that his effort might contribute in some way toward the development of a theoretical perspective from which useful guidelines could be drawn for research, and for the production and use of audiovisual instructional materials. It was *not* the intent of the project to *make* a theory of analogical signs, but rather to examine the state of the theoretical literature and to chart the orientations that have been operative in selected representative writings and research.

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[*] The terms, "iconic," and "analogical," will be used interchangeably. Despite the fact that "analogical" was the term used in the original statement of the purpose of this study, "iconic" will be favored because its usage is more clearly established in the philosophic literature from which it was derived.

[**] As it will be explained, the term "sign," as used in this monograph, includes "symbol" as a sub-category.

The study was called a survey in the sense that it involved a rather thorough-going search of bibliographic sources, as well as interviews with persons who had conducted, or were conducting, relevant research or theoretical writing in widely scattered locations throughout the United States. However, no attempt was made to compile a universal or microscopically complete compendium of every research report and every bit of writing that might be related to the subject. The aim was the more modest and realistic one of preparing a bibliography that would be representative and reasonably comprehensive, giving emphasis to the recent and current research. It was anticipated that any treatment of the theoretical literature would necessarily be somewhat selective, and would tend to reflect the interests and biases of the author -- at least with respect to what sorts of underlying philosophic, psychological, or other considerations are related to the subject. Indeed, anyone who chooses to read further into this report deserves the courtesy of knowing just what the author thinks the whole thing is about, and that will be considered next.

It should be noted at the outset that this is not a survey nor a bibliography of audiovisual research and theory. The subject is a good deal more limited in that it has to do only with those components of messages, instructional materials, communicative stimuli of whatever sort, that can be described properly as "iconic." The subject is "iconic signs." As employed in this report, the term, "sign," will denote any object, picture, word, or other symbolic device used to convey or gain information. The sign typically represents or "stands for" something else: an object, event, or state of affairs. It has significance or meaning not by virtue of what it is in itself, but rather what it portends, or tells us about something else. An "iconic sign" is one that bears a special kind of relationship to its referent. Following the earlier work of Charles Saunders Peirce (to be mentioned again, later) Charles Morris defined the "iconic sign" as one that looks like the thing it represents. A picture or three-dimensional model of an object would be obvious examples of iconic, or analogical signs. It should be noted that signs may be iconic in varying degrees. Some pictures are highly realistic and bear a kind of one-to-one semantic relationship to a particular object or "identity category" (13). Others are schematic and obviously do not represent a specific object, but rather a class or category of objects. A graph used to represent quantitative relationships would be another example of a partially iconic sign or symbolic device.

Once the suggested definition of "iconic signs" has been noted, it is apparent that a great deal of audiovisual research is concerned with the effects of various kinds of media presentations in which iconic signs, as such, do not constitute the experimental variable. Studies of instructional motion pictures, for instance, have not ordinarily attempted to make a clean separation of the effects of the pictorial part of the presentation from the verbal. This is not a criticism of such audiovisual research, per se, but it does have some important implications with respect to the development of a theory of audiovisual instruction. If we look for the distinctive or truly characteristic element in most audiovisual presentations we must go beyond the medium to message components, and this seems inevitably to involve some effort to deal with the special characteristics of pictorial or other signs that look like the things they represent. It is this effort to define and explore the nature of iconic signs, as reflected in the research and literature, that constitutes the focal interest of this study.

It will be noted that the text thus far has dealt exclusively with the term, "iconic" (or "analogical")"sign," with no mention of "symbol," although the latter word was included in the original proposed title of the study. The primary reason for this is to gain simplicity of style by using the single, generic term, which often is employed in philosophic and linguistic discussions to encompass at least two sub-categories, of which "symbol" is one. A distinction may be drawn between "natural" and "artificial" signs--the latter, frequently called "symbols," have an arbitrary character in that they have no "natural" or direct connection with their referents (27). Clouds are a natural sign of rain, but the word, "rain," is an artificial sign, a symbol, which derives its meaning in a different way, and which can be used to denote, or talk about, rain under conditions when the natural signs of rain are absent. Charles Morris drew a somewhat similar distinction between "signals" and "symbols," the latter defined as "a sign produced by the interpreter which acts as a substitute for some other sign" (67:25).

Charles Sanders Peirce was probably the first American philosopher to distinguish a class of signs which stand for their referents merely because they resemble them. Such signs he called "icons"--other signs falling into two additional classes: "tokens" (or symbols), and "indices."* The "token" was a conventional sign, related to its object as a consequence of mental association, or habit. Indices and icons, on the other hand, were connected with their objects in a different way--the "index" by virtue of some direct effect of the object upon the sign, itself; the "icon" by virtue of its resemblance to the thing it represents (71). As employed in this report, the terms "iconic sign," and "analogical sign" will be used interchangeably, and will encompass both "indices" and "icons," as Peirce used these terms. The author reserves the option of using the term "iconic symbol" in some cases where the sign in question is iconographic in origin but has acquired some degree of conventional meaning. Indeed, it would appear that there are many instances where the use and/or rendition of iconic signs has become somewhat stylized, with some shading of the iconic or "natural sign" effect into the symbolic --a condition that can also be noted, historically, in the transition of pictographic written languages into highly stylized and ideographic forms. In other words, it is my impression that the line between icon and symbol is not always hard and fast, and frequently quite hazy. Some icons, such as the cross, have become predominantly and powerfully symbolic in effect.

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*Actually, Peirce's analysis of signs was much more complex, involving two other dimensions of classification and a total of nine categories, but there is no need to go further into his work here.

ICONIC SIGNS AND REALISM IN INSTRUCTIONAL MATERIALS

Focalization of interest upon the iconic sign, as such, is a comparatively recent development in audiovisual theory and research, despite the fact that the field has always emphasized the realistic quality in instructional materials. One of the earliest textbooks, Visualizing the Curriculum, by Hoban, Hoban, and Zisman (48), included a theoretical discussion in which it was proposed that the value of visual aids depends primarily upon their "degree of reality" and "the nature and extent of the pupils' previous experience."

This early statement, published in 1937, helped to set a pattern which has been followed quite consistently in the audiovisual literature for almost 30 years, in the sense that most proponents of audiovisual methods and/or materials have assumed their value has something to do with a quality that sets them off from purely verbal materials, and that this distinguishing quality may be denoted, crudely, at least, as "realism" or "concreteness." The first edition of Edgar Dale's influential textbook on audiovisual instruction helped to dramatize the value of concrete elements in instructional materials through the use of the graphic device he called the "cone of experience."

Despite the fact that none of the prominent advocates of "realism" in instructional materials has ever claimed this attribute should be used indiscriminately as a sole measure of effectiveness or value of instructional materials, audiovisual education has been attacked from time to time, and from various sources, on the grounds that the values of "realistic" experiences in education have been exaggerated, that such methods may tend to discourage the use of printed materials or even interfere with the development of good reading habits, and for other reasons that will be discussed presently. Such charges, often unsupported by research evidence, tend to prompt counter arguments which also may or may not be supported by the reported findings of experimental studies. This is not to say that purely theoretical discussions of the matter are fruitless, nor even that they are unnecessary. Such exchanges prompted James Finn's analysis of the controversy in terms of C. B. Snow's theory of the cultural rift between the scientific-technological community and the literary intellectuals.[*] The argument over the value of "realism" in instructional materials has also prompted the response that it is really pointless to talk about a *conflict* between pictures and words since they are not truly alternative nor rival means of communicating information, but actually perform complementary and mutually sustaining roles in instruction.[**] However, it should be noted that there is nothing very new about the notion that iconic and verbal signs bear a reciprocal relationship. Hoban made this observation as early as 1942 (46:28).

Perhaps the primary question is not so much the relative value of pictures or other "realistic" materials, as against the verbal, but what is their nature and what role do they actually perform in communication and teaching. Looking back in time, it is somewhat surprising that it has taken so long to frame this question sharply, and begin to make it a matter of explicit experimental concern. The problem was there in the earlier research and theoretical discussion, but usually it was implicit or clouded by an experimental attitude preoccupied with media effects rather than message components. There were, to be sure, a number of studies which involved inter-media comparisons, or comparisons of audiovisual presentations with "conventional" teaching that employed predominantly verbal materials, but the results of such studies were almost invariably directed to questions that did not attempt to make a sharp distinction between the parts or elements of audiovisual messages, as iconic and verbal. Hence, typically there was verbal material in both the experimental and control versions, or in all of the several media undergoing comparison, with pictorial material added to the verbal (but not necessarily the same verbal) in the experimental variable or variables. From such comparisons it seemed reasonable to conclude that gross quantitative differences in learning results might be attributed to the additional factor of pictorial material, in the case of the audiovisual medium, but it was obviously impossible to draw any conclusions about the precise differential effects of the iconic and the verbal.

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[*] Finn, James D. "The Tradition in the Iron Mask." *Audio-visual Instruction*, 6:238-243; 1961.

[**] Norberg, Kenneth. "Visual and Verbal Paths to Learning." *Teachers College Record* 54;319-23; 1953.

Lumsdaine and May (60), in a recent review of mass communication and educational media research, pointed out the disadvantage that this field of study is defined in terms of presentation mode rather than some more fundamental basis.

They also noted a diminution in "over-all gross methods comparisons," and a corresponding increase in studies that attempt to manipulate specifiable variables. This tendency has been especially noticeable in recent research in programed instruction. But much of programed instruction is verbal, and usually the experimental variables have little or nothing to do with the nature and/or functions of iconic signs. Of course, it would be inaccurate to say that nothing at all had been done until recently. In order to reduce the concept of "realism" in instructional materials to a workable hypothesis it was necessary to translate it into terms of an acceptable model of human behavior and learning. Carpenter (16) took a significant step in that direction when he proposed the applicability of the"sign similarity" hypothesis in 1953. Similarly, Miller (66) related "realism" to the principle of stimulus-generalization; i.e., a response learned to one cue can be elicited by other similar cues. Thus, "realism" was assimulated to the framework of S-R learning theory. A number of the studies in the Instructional Film Research Program, conducted at Pennsylvania State University under the leadership of C. R. Carpenter, dealt experimentally in one way or another with the relative functions of words and pictures, and to some extent with various ways of using pictorial material to produce learning effects. In his doctoral study (of simple rote associative connections, through paired associates), Lumsdaine (59) found that his subjects scored best on picture-word combinations, least well when the order was reversed to word-picture. In a similar vein, Kopstein and Roshal (57) compared pictorial and verbal stimuli in teaching Russian words to Air Force basic trainees and found that pictorial stimuli produced better results. These, and numerous other significant studies, provide solid empirical data, and pose some highly interesting theoretical questions that deserve much further study. A question of considerable interest is how far research involving comparisons of verbal and pictorial stimuli can go until we have a more fully developed theoretical base. We will return to this question later.

In 1957, Neal E. Miller, discussing motion picture research, suggested that "--a more useful dichotomy than the visual versus the auditory is the contrast of pictorial and verbal presentation," (66). The auditory track of a motion picture is usually mostly verbal, but not necessarily so; and verbal material may appear in visual form in the picture track of a film, as it does in printed materials. Charles Hoban, in 1960, pointed out that the earlier film research had been "device centered," and that little research since then had shed any light on the "differential and interacting roles of pictures and language in films." He added that, "Without a fundamental understanding of the roles of each medium, it is difficult to deal with the problem of best employing both of them, simultaneously or sequentially. Yet, this is what must be done in practice with illustrated books, silent or sound film strips, motion pictures, and television" (47:102). But what does a "fundamental understanding of the roles of each medium" entail? Some might argue that theoretical constructs already available are adequate, without further speculation regarding special classes of signs -- or even that further theoretical development is either gratuitous or must await a better accumulation of empirical evidence. Others, perhaps, would say that before we can frame further good experimental questions we ought to try to get a better description of the thing we wish to investigate. Just what _is_ an iconic sign, and how does it differ from other sign-stimuli? The problem of the place of the picture, can be brought into sharper relief, perhaps, by examining some of the different routes by which it can be approached.

The theoretical literature dealing with the subject of iconic signs is not very plentiful, and some of it lies in the area of philosophy and linguistics, beyond the scope of this study. Moreover, germaine psychological aspects of a theory of signs are imbedded in treatises on learning, communication and perception, as well as writings on the subject of signs, per se. In the ensuing discussion, we will deal with several representative and recent attempts to deal with "realistic" instructional materials, in learning, in perception, and as involved in the transmission of information. In addition, we will take account of two rather isolated studies that attempt to deal with the subject of iconic signs "head on." It will be noted that some of these efforts are either framed explicitly in terms of the S-R approach to the study of behavior, or at least seem to fit readily into that framework; whereas others seem not to lend themselves completely, or readily, to the S-R paradigm. The conclusion of the analysis will attempt to relate certain issues in perception theory to the problem of the development of a theory of iconic signs.

THE STIMULUS-RESPONSE PARADIGM

A great deal of the theoretical and research literature on audiovisual education reflects rather distinct tendencies which stem from the broad domain of what is sometimes called "S-R psychology." In accordance with the S-R paradigm, the psychologist is typically concerned with three important sets of variables: stimuli, responses, and the association between them (53). From a methodological standpoint, the S-R psychologist is anchored in the behavioristic tradition which requires a highly empirical approach to the investigation of behavior. His attention is focused upon the process of conditioning by which desired responses are associated with appropriate stimuli, and he is often inclined to place considerable emphasis upon reinforcement as a means of accomplishing this end. Crudely stated, reinforcement theory holds that if a learner is "reinforced" for making a correct or desired response to the appropriate stimulus, he will be more likely to make that response when the same stimulus occurs at some future time. Howard H. Kendler has proposed that S-R psychology probably affords the most useful language and methodology for the study of audiovisual instruction, although theories of learning or instruction do not necessarily demand an S-R analysis (53:33). It is hardly necessary to note that a great deal of audiovisual research, in fact, most of it, rests upon the theoretical base of S-R psychology. This has become increasingly evident in recent experimental studies of programed instruction. However, S-R oriented research studies and theoretical writings related to the more specific topic of this monograph are not so plentiful.

George L. Gropper is one of the relatively few psychologists who recently have devoted both experimental and theoretical efforts to the study of non-verbal pictorial materials, as such, from the standpoint of S-R learning theory. In his own words, Gropper sought to explore how "--non verbal, visual materials may be used to promote the acquisition, retention, and transfer of the responses we define as knowledge." (36:2). He has undertaken a description of visual materials"--in terms of an objective, stimulus-response language." (36:1). Gropper's work centers upon the use of non-verbal "visuals" in instruction to cue or reinforce desired responses. His approach is similar to that employed in a recent analysis of communication by Frank R. Hartman as "the study of ways of arranging stimuli to produce desired responses by the organism" (41:156). Gropper proposes that visuals may be used to accomplish two types of results: (a) to cue and reinforce responses that we wish to add to the student's repertoire, and (b) as examples to foster generalization of responses to new situations. Visual stimuli may be used to cue responses so that control over these responses may be passed to other stimuli, usually verbal; or they may be used to bring particular responses under their own control. The two functions are represented by "intermediary" and "criterion" visuals.(36:5-6). In using intermediary visuals, the choice between a visual or some verbal alternative may depend upon "logistical" considerations having to do with the number and complexity of responses a given visual might serve to cue. The more responses under the control of a stimulus, the greater the likelihood that the stimulus might cue responses which can compete,or interfere with, the desired response. On the other hand, the complexity or "density" of the visual stimulus material may not be a disadvantage--may, in fact, become the opposite, if its use is properly controlled, say by directing attention to appropriate features of the visual and thus assuring an efficient sequence of responses.

Gropper does not pretend to offer a fully-developed theory, but he does propose some generalizations regarding the effectiveness of visuals. He notes that non-verbal visuals may have a peculiarly powerful effect as reinforcers because of the ubiguity and strength of visual confirmation of behavior in every-day situations. He also suggests that visuals may have peculiar advantages in cueing some kinds of responses, as well as disadvantages in cueing others. Much more research and theory is needed to determine how generalized responses may be acquired through visuals, and the relative potentials of visual and verbal stimuli in general.

In the concluding section of Gropper's monograph, the following statements are especially interesting: "--Perhaps it will always remain an empirical matter just how many words any given picture is worth. For anyone willing to pursue such an accounting venture, it should be easy enough to determine empirically how many words it actually takes to match a visual's capacity to aid students to acquire, retain, and transfer specific responses or classes of responses. --A more worthwhile venture would appear to be--finding out in analytic and systematic ways how the control of student behavior by visual means can aid the effectiveness of instruction (36:35). But what would an "analytic and systematic" approach to further study in this area entail? And to what extent does the initial choice of the S-R paradigm set limits to such a venture?

The modern psychologist, working in the behavioristic tradition, tends to avoid proliferation of theoretical constructs. In a recent publication on learning theory as applied to audiovisual instruction, James Deese, in his summary article, selects a quotation from another con-- tributor to the same publication (Leo Postman) as a proposed "motto for AV research." "The analysis of the process of audiovisual education does not call for the formulation of special principles; it calls for the application and elaboration of the general laws of human learning."" (63:86). There is much to be said for this point of view. Although not necessarily behavioristic in orientation, it supports the clean simplicity of the S-R paradigm, which has proved itself such a powerful tool for modern behavioral research. But theoretical models of behavior, or that aspect of behavior called learning, cannot have simplicity, and the strength that goes with it, without giving up something in return. If the stength of the S-R paradigm is also its weakness, that weakness, in this case, may inhere in the circumstance that "visuals" are cast in the role of "stimuli" that are just externally and independently "there," prior to response. The question is whether this rather tight fitting of the "visual" or iconic sign to the S-R paradigm allows sufficient flexibility in theoretical formulation and/or experimentation to freely and fully explore the functions of visual communication in teaching. In order to examine this question further, it may be helpful to examine other theoretical and experimental developments, mostly recent, some of which follow closely the S-R paradigm, some of which do not.

THE PSYCHOPHYSICAL THEORY OF PERCEPTION

In the context of S-R learning theory, the hypothesis of stimulus generalization affords a means of explaining the function of sign-stimuli that resemble other stimuli. A good reason for using a picture or other substitute stimulus is to obtain the same response that would occur in the presence of the original. Thus, from the standpoint of perception theory, a good substitute stimulus (if that is what the stimulus is for) is one which resembles the original as closely as possible. In order to fabricate or arrange such stimuli we must know what makes a picture, or other iconic sign, look like its referent. This is one of the dominant concerns, if not the dominant concern, of psychophysical theory as applied to the perception of pictures.

A classic statement of psychophysical theory as applied to iconic signs is provided by James J. Gibson's 1954 article, "A Theory of Pictorial Perception" (35). In this paper Gibson noted that perception enables us to make discriminations among features of the physical environment, and to identify objects, places, and events so that appropriate responses can be made to sensory impingements from the surrounding environment.

Frequently people have to be trained in situations other than the original or "real" environment in which the learned behavior will later be practiced. Thus, there is a need for substitute or "surrogate" stimuli which are relatively specific to objects, places, or events not at present affecting the sense organs of the perceiving individual. An important assumption is "that direct perceptions correspond to realities, or rather that they come more and more to do so as the perceiver learns. Accordingly we are primarily interested in how perceptions mediated by surrogates also come to correspond to realities" (35:7).* Thus Gibson's focal concern is the problem of fidelity in pictorial surrogates. A faithful picture is defined as one which reflects or transmits a sheaf of light rays to a given point which is the same as would be the sheaf or rays from the original to that point. In general, a good pictorial surrogate is one which corresponds to the original with maximum fidelity. However, pictorial (replicative) surrogates may vary with respect to their degree of realism, or the extent to which they actually duplicate the features of the original object. Thus, between purely replicative surrogates such as realistic pictures, on the one hand, and purely conventional surrogates such as verbal and other abstract symbols, on the other, are "mixed surrogates" which may combine both concrete and general features of that which is represented. As for the relative values of the several varieties of surrogates, "Pictures and models are better than words and symbols for learning about concrete things--" whereas, "Words and symbols (including graphic symbols and geometrical drawings) are essential for learning about properties, variables, groups, classes, and universals," and of course words are needed to manipulate propositions and to form new ones (35:22).

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*It should be noted, of course, that this article was written at least 12 years ago, and may not reflect the author's views as he would state them at this time.

The import of Gibson's 1954 analysis seems quite clear. What we perceive is what is given, what is antecedently "there" in the external world, and the function of the replicative surrogate is simply to satisfy conditions supplying a pattern of retinal stimulation which closely approximates that which would occur in the presence of the original. The conditions are physical and can be described in mathematical terms. Just how learning results from perception is not systematically discussed in this article; after all, the article is about pictorial perception, not about learning. But the implication which seems to underlie the entire discussion is that what we learn from perception is just what we see, or what is "given" by the initial visual stimulation. The strength of this position is that it is not only highly plausible, but in one sense undeniably true. Its weakness, if it has one, is that it leaves out of account the variability of perceptions under constant or similar conditions of retinal stimulation. This is not to deny the importance of considering what constitutes fidelity in a pictorial surrogate, nor the obvious instructional advantages of being able to simulate objects and other environmental conditions not directly accessible to the learner; rather to note a distinction between a psychology of replicative surrogates and a more comprehensive psychology of perception as related to learning.

In 1962, a special issue of AV Communication Review was published on the subject of "Perception Theory and Audiovisual Education" (69). This issue contained a paper by Hochberg (49) which continued the psychophysical line of analysis with regard to the specification of stimulus variables that control our perceptions of pictures. This highly informative survey explored such problems as what constitutes a (perceptual) edge, what makes a figure look like a solid object, the psychophysics of represented form. Hochberg also emphasized the need for further development of this important area of research.

In the same issue of AV Communication Review, a transactional account of perception and audiovisual learning was outlined by Hans Toch and Malcolm McLean. This recent review of the transactional position, emphasized the active and creative aspects of perception--posed the idea that perception is not just a passive registration of some external state of affairs, but in some measure actually constitutes the "reality" that each person perceives. There is no need, here, to open up the old controversy between psychophysical and transactional psychologies.[*] However, it is of some interest to note that the issues were still alive in 1962, as they are today, and may remain for some time to come. To say that the issues are "alive" is not to imply that they are prominently or frequently discussed, explicitly, in the psychological or educational research literature--quite the contrary. The issues are alive merely because some of the same underlying (often implicit) assumptions are still operative in divergent styles and interests that characterize current research and theoretical development. A good case in point is the important and challenging work recently reported by Robert M. Travers and associates, to be discussed next.

Before going on, it should be noted that the brief mention of transactional psychology in the foregoing discussion was introduced merely to accentuate the fact that psychophysical psychology, in accordance with its S-R orientation, is concerned with the problem of reliably producing a desired response, in the presence of a given stimulus; whereas the transactional psychologist tends to be interested in variability of response under constant conditions of stimulation. Some possible implications of this difference will be expanded later.

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[*] See the exchange of articles between James J. Gibson and Kenneth Norberg in AV Communication Review, vol. 1, nos. 3 and 4. Also Norberg's earlier article in vol. 1, no. 1.

AN INFORMATION THEORY APPROACH

Drawing upon the literature of experimental psychology (and to some extent upon their own research) Travers and his associates (83) have constructed a theoretical model for the "transmission of information" by audiovisual materials. In a broader sense, they offer an approach to the study of perception in terms of information theory as applied to psychological research, drawing upon the prior work of Broadbent (11) in particular. Essentially, the proposed theory is a close adaptation of Broadbent's model of the human information processing system which features the notion of a limited capacity channel ("P system") fed through a selective filter from a short-term storage reservoir of sensory inputs--a concept which is fully described in Broadbent's 1958 publication, Perception and Communication (Pergamon Press). Travers' adaptation provides for a "compression" stage as information enters at the receptors, and for some elaboration of the processes presumably subsumed under Broadbent's "selective filter." The central idea is that of a single-channel data utilization system which passes only one message at a time. Thus, in tracing the implications of his model for the use of audiovisual materials, Travers is particularly critical of the notion that multi-media presentations increase learning by virtue of the plurality of media involved. He holds that exactly the opposite effect may result when too much information is presented through two channels simultaneously, unless the density of information and rate of presentation is sufficiently low to compensate for overloading by which relevant information may be lost. For similar reasons Travers concludes that emphasis on realism in instructional materials is the "worship of a false god." The intelligent use of information by human receivers is a highly selective process which may be impeded by the presentation of realistic and irrelevant detail.

In order to understand Travers' position it is necessary to examine some of the experimental studies from which his conclusions are drawn. In one study by Van Mondfrans and Travers (83) nonsense syllables and words were presented to subjects in three different modes: visually, by sound, and by the two modalities combined. In terms of the quantity of material recalled, it was found that at lower speeds of transmission there were no significant differences among the three modes of presentation, i.e., it didn't matter whether the syllables or words were presented visually, in spoken form, or in "AV" combination. When the information was presented at higher speeds of transmission, "a significant decrement was found in the AV presentation." The lower effectiveness of the combined audio and visual presentation, as compared with single channel transmission, was attributed to interference of one mode of transmission with the other.

In a similar experiment involving passages from a reading text, (83) it was found that AV (combined audio and visual) presentations did yield better results at higher speeds than single channel, but it was also observed that subjects tended to block one channel or the other. This was interpreted to mean that, when dealing with meaningful reading material, some subjects do better with the visual channel, some with the auditory--so a given subject may select his favored channel and block out the other. Thus, assuming selective screening of one channel or the other, the superior over-all result for the AV presentation is still consistent with the single-channel model of information transmission.

In a third experiment by Chan, Mondfrans and Travers, (83) a set of nonsense syllables was prepared in two forms, one with special type and in color against a decorative background, the other in plain black and white letters with no decorative background. A different set of nonsense syllables was prepared for auditory and simultaneous presentation with the visual sets. Thus, each time a subject was exposed to a visual nonsense syllable he heard a different (and potentially competing) nonsense syllable at the same time. One group saw the colored and decorated visual presentation, the other the black and white, each with the accompanying auditory stimuli already described. In terms of the total number of visual and auditory syllables recalled, both groups performed about the same; i.e., the difference was not statistically significant. The group that saw the colored and decorative presentation had better recall of the visually presented syllables, but at the expense of the auditory channel. The results with the other group were just the reverse.

With respect to the findings of the studies just mentioned it is of primary importance to keep in mind the fact that they deal exclusively with verbal symbols, whereas most two-channel presentations actually used in instructional situations typically combine non-verbal signs in the visual channel with verbal auditory stimuli. Thus, with respect to the publication now under discussion, it is apparent that the theoretical statements regarding plural media presentations and "realism" relate to the sheer quantitative density of the information being processed. The research method involved is powerful, and the findings are very useful, but there may be some question about the extent to which theoretical statements regarding "realism," based upon such findings, can be generalized.

In view of the comment just made, the reader might be inclined to ask why that particular research is considered in this monograph on iconic signs. The answer is simply that there is no way to read the implications of a given line of investigation, on its face value, without taking the theoretical assumptions underlying the research into account. In this case, we are dealing with a research and theoretical treatise which has something to say about the factor of "realism" in instructional materials, and thus presumably about iconic signs. In the effort to reduce all messages to homogeneous "bits" of information, information theory tends to discount and/or ignore qualitative distinctions among classes of signs. Thus, "realistic" signs may be construed as relatively "dense" packets of information. Some implications of this tendency will be discussed in the concluding section of this analysis.

Thus far, we have dealt with several strands of theory and research which approach the subject of iconic signs from the standpoint of learning, perception and communication. Each of these strands was selected for discussion because of its explicit or implicit interest in the subject of this study, and because it reflects a common behavioristic orientation and is compatible with, if not explicitly based upon, the S-R paradigm. A common concern is the problem of getting the learner or the receiver of information to make a known and pre-identified response-obviously, one of the dominant concerns of all instructional enterprises. Thus, the teacher is interested in identifying stimuli which will dependably elicit known responses, and often, in transfering the control of the original discriminating stimuli to others--for the sake of producing the desired response under appropriate stimulus conditions. A similar interest is implied, I suppose, in the concept of information transmission, except that the communication theorist is not necessarily concerned with the total problem of learning. He merely wishes to make sure that the intended stimulation (or information) is actually processed by the learner. Similarly, the perception theorist, in this framework, deals with the problem of contriving stimuli that will reliably produce a given response. In all of these cases, there is a tendency to avoid consideration of the qualitative characteristics of classes of signs except where features of such stimuli can be quantified or reduced to relatively simple geometric properties. To a certain extent, all signs are put on an equal footing, in that the important thing to know about a given stimulus is that it will produce a certain response--and whether it will do so is largely a matter to be determined by empirical means.

Recently, a few investigators (very few) have centered their attention upon the nature and characteristics of the iconic sign, as such. Two examples of this trend (?) will be considered. In the first, the investigator has chosen to study a limited class of iconic signs, involving elements of expression of the human face. In the second, an effort has been made to explore the nature of the iconic sign, as such. It should be noted that these theoretical and experimental explorations, to be examined next, are not marked off as departing from the behavioristic orientation and rigorous quantitative methods of the studies already discussed. Not at all. In the first of the two, it will be seen that at least some qualitative features of iconic signs can be standardized for purposes of experimental study. The second, a theoretical study, would seem to introduce additional variables that might very well complicate some of the more common S-R experimental methods. Whether some of the procedures used to test its hypotheses would have to be less formal, less rigorously quantitative, may be a matter of conjecture at this point. What is perhaps more important is whether such a theory of iconic signs is compatible with the S-R paradigm, and in what respects it might require a different perspective.

NONVERBAL COMMUNICATION AND PICTIC ANALYSIS

In a recent doctoral study, Harrison (4) demonstrated that the elements of given facial expressions can be encoded so as to produce reliably certain responses. In the introduction to his report, Harrison makes the observation that almost every communication situation has a nonverbal component, that this component frequently has an influence on the outcome of the situation, and that it is likely to operate at a low level of awareness. Calling upon such sources as Edward Hall's "The Silent Language," (38) Ruesch and Kees' "Nonverbal Communication," (75) and Ray L. Birdwhistell's "Kinesics," (8) Harrison musters support for his primary assumption regarding the ubiquity and power of nonverbal elements in human communication. His own work appears to be related to that of Birdwhistell, who developed a notational system so that he could make precise, moment-to-moment recordings of body attitudes and movements, a method which has recently been focused upon analysis of behavior with respect to mental health problems.

Harrison's study of facial expressions involved the development and use of simplified facial "pictomorphs," schematic facial drawings with a circular head and a variety of types of eyebrows, eyes and mouths. For instance, five types of brows were used: (1) a "neutral" brow, straight and horizontal, (2) a raised brow, straight and horizontal but high in the face, (3) an upturned brow, raised medially (4) a single raised brow, and (5) a downturned brow, lowered medially. In addition, four eye types and three mouth types were generated, so that it was possible to combine the various available facial elements in 60 different combinations. Seventy potentially descriptive adjectives were then selected, and subjects were asked to compare adjectives with faces, rating each adjective on a five-point scale as to the degree it was considered appropriate for each face. Data analysis revealed that some of the pictorial elements produced reliable responses. For instance, the adjective, "happiness," was consistently related to the upcurved mouth, "worry," to downturned mouth and medially upturned eyebrows, "anger," to medially downturned eyebrows, and "boredom," to half-closed and fully closed eyes.

A THEORY OF PICTORIAL COMMUNICATION

James Q. Knowlton has developed a theory of pictorial communication focused upon social and psycho-linguistic factors (56). Starting with the assumption that further theoretical and experimental development of this area requires a unit of analysis, he describes his monograph as an effort to develop a "metalanguage" for talking about pictures" (56:ii). The dominant linguistic orientation of Knowlton's study is indicated in the following quotation: "Whether or not a pictorial symbol signifies depends upon whether or not the intended concept has already been attained by the interpreter of the symbol; and this last is preeminently a linguistic accomplishment" (56:1.1-1.2). To a large extent, the function of pictures is to aid in the development of the linguistic conceptual structure within which they have meaning. But pictures also have certain unique functions which mark the limitations of language as a tool of thought. (Some of these will be mentioned presently.)

As a preface to his study, Knowlton undertakes a critical analysis of audiovisual research. He argues that the main trouble with this field of inquiry stems from its preoccupation with media, and its lack of a suitable, carefully defined unit of analysis: specifically, the pictorial sign. Media presentations, such as sound motion pictures and television programs typically offer a mixture of pictorial signs and verbal symbols. Thus, when an audiovisual medium is compared, as an experimental variable, with some "conventional" (say, exclusively or dominantly verbal) mode of presentation the results must be inconclusive because there is no way to satisfactorily describe the unspecified "mix" of pictorial and verbal elements that constitute the audiovisual presentation. We don't know what behavioral results may be due to pictures, what to words, much less to unique combinations of these two classes of signs. Audiovisual research ought to be focused upon the distinctive component in audiovisual messages, which is the picture. To develop a science of audiovisual communication we must first describe the unit for analysis--the pictorial or iconic sign. Knowlton was not the first to note this need, but he was certainly one of the first to engage in a major effort to do something about it.

In the compass of this report it is difficult to present anything approaching a summary of Knowlton's monograph on pictorial signs, and do justice to it. In this context it will suffice to emphasize the fact that he would advise investigators of communication and teaching to pay attention to the qualitative differences among classes of signs. In this respect he is in the philosophic tradition of Charles Sanders Peirce (71), who was the first modern philosopher to discuss iconic signs (which he called "icons"), and Charles Morris (67), who introduced the more recent term, "iconic sign," meaning a sign that looks like the thing it represents. Despite their dependence upon the linguistic context of the culture, pictorial signs have important differences, limitations, and powers, as compared with speech. Knowlton underlines the fact that linguistic science has already provided important observations regarding some of these differences. For instance, speech requires little energy, a minimum displacement of other activities, depends upon the vocal-auditory channel, is independent of light, non-directional, and rapid-fading. A person who can interpret a language can also produce it.*

Knowlton emphasizes the fact that it is not very useful to talk about the value of pictures, or iconic signs, in general, or as an entire class. The communicative value of a given picture depends, in some important measure, upon what we wish to signify. An "identity category," (specific referent) calls for a highly iconic sign; an "equivalence category" (concept), may be signified by using a schematic drawing with little or no realistic detail. But realistic iconic signs often "say too much," and schematic symbols may become too barren. In all cases we must remember that language is the prime technology of the human mind, the master learning set, and we should use pictures to further the learner's command of verbal processes. Pictures used improperly, or in the wrong context, may even interfere with the operation of logical processes inherent in language. Our initial perceptions of the world do not provide an immediate grasp of reality. What is needed is a means of operating upon perception, when it is false; or going beyond it, to deal with concepts. The logical system inherent in language is an indispensible tool for this task (56:5.55-5.56).

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*This, and the preceding list of characteristics are based upon Charles Hockett's analysis of "design features" of speech.

On the other hand, language has its distinct limitations. There are certain kinds of special tasks for which pictures are uniquely suited, or even indispensible. Pictures may lend strong dramatic impact to certain kinds of messages, and thus facilitate acceptance. Pictures may be used to deal with aspects of the world that have not been encoded in language. Even more interesting is the suggestion that iconic imagery may play a critical role in the behavior of invention "where language may be of little use in the first coping with fundamentally and distinctively new problems" (56:6.17). Knowlton's description of iconic signs includes not only realistic pictures, but also "logical pictures" and "pictorial analogies." In a summary statement dealing with the latter types of iconic signs he observes that, "Iconic representation would seem to have a widely ignored potential for portraying' non-phenomenal matters, especially theories; or, more generally, for making the unfamiliar familiar through pictorial analogy or through pictorial analogy by extrapolation--" (56:6.35).

Earlier in the discussion, it was suggested that S-R learning theory, psychophysical perception theory, and the information transmission approach to communication theory all seem to have certain tendencies in common. While the learning theorist seeks to describe the conditions under which control of a desired response can be passed from one stimulus to another, and the perception theorist is more interested in specifying stimuli that will evoke certain responses--both are inclined to look for statistically reliable connections between "S" and "R", and not to have a high degree of concern for qualitative analysis of categories of sign-stimuli. The psychophysical perception theorist does study the stimulus event, but he is careful to confine his analysis to geometric properties which are compatible with his exact quantitative methods. The influence of the S-R paradigm is, perhaps, less apparent in the case of Travers' study of the communication process, except that here, too, there is a relatively low degree of concern for qualitative differences among classes of signs.

What, then, might be the contrasting significance of the experimental work of Harrison, and Knowlton's theory of pictorial communication? Harrison is quite reductive and precise in his analysis of facial expressions, but he does start with the assumption that certain irreducible qualitative elements, as formalized in the "pictomorph," warrant study in their own right. Knowlton's more com-- prehensive theoretical analysis takes the bull by the horns in an effort to develop a metalanguage for qualitative description of the pictorial sign, even though this leads him into some relatively unexplored and speculative areas.

It may be useful to consider why one group of investigators is satisfied with a method that tends to ignore or swallow up qualitative differences between categories of signs, while the other begins by making such qualitative distinctions a matter of primary concern. One clue to the answer may be found in the distinction between "linear" and "non-linear" signs proposed some time ago by Susanne Langer (58), and others.

PERCEPTION AND NON-LINEAR SIGNS

While Langer used the terms, "linear," and "non-linear" to distinguish between verbal and iconic signs, it has already been noted that some theorists tend to ignore or discount this distinction, with the net result that the total communication process seems to fall into the pattern of a simple linear progression of signs (whether verbal or non-verbal, or both), each sign depositing its particular load of meaning as it arrives at the terminus of the transmission system. The point is not that pictorial or other iconic signs cannot be used in a linear fashion; within limits, they can be used this way, with some help from verbal signs--but when this occurs they become quasi-verbal symbols, conventional signs that have surrendered some part of their distinctive power as iconic signs.

Non-linear (iconic) signs have a unique function in human communication and learning. Langer's discussion of "linear" and "non-linear" signs stresses the sequential ordering, the strung-out arrangement of linear signs in time, as opposed to the all-at-once character of the non-linear sign or presentation. But the distinction deserves further analysis. Single pictures or more complex iconic displays may be said to be non-linear not merely because one beholds an entire visual array, all at one time, but because what is perceived has a degree of independent meaning, or openness of meaning, by virtue of the fact that it is not constrained by its place in some grammatical structure of which it is a term or part. The beholder who encounters an iconic sign or display is of course not cut off from prior experience. He always relies upon a deposit of past experience, what Kenneth Boulding has described as the "Image" (10), to cope with the present. But this sort of linearity, this cumulative building of meaning which enters into all perceptions, is something quite different from the formal linearity of signs which are bound together in the grammatical structure of a lingual statement. The "non-linear" sign, or presentation, is free of the latter control, but not the former. However, its freedom from grammatical constraint may be an important factor in the generation of meanings which require modification of given categories, or the development of new ones.

This is not to imply that iconic signs or "non-linear" presentations have some exclusive magical power of their own to generate new meanings, which is wholly independent of lingual communication. New insights cannot be instituted as meanings in the human community without lingual formulation, whether accompanied by the invention of new terms or reinterpretation of terms already in use. And once a new idea has been formulated, the development of its widely ramifying elaborations and implications may magnify and spread the impact of new meaning through lingual means. There is no need to acknowledge the importance of the linear or lingual sign as representing the dominant mode of human communication. Language is the dominant mode of communication because the need to disseminate knowledge already gained, and to formulate and develop the implications of fresh experience, overshadows the little understood function of raw "non-linear" elements in the communicative process. Perhaps it is because of the dominant role of language that there is a tendency in some strains of perception theory, and related communication theory, to ignore the distinctive "non-linear" character of iconic signs and then to discount their importance because they don't serve the function of "linear" signs as well as lingual signs do. Of course they don't do that, and shouldn't be so employed because a picture ordinarily has no business merely "standing in" for a word, just as a word can't and shouldn't be expected merely to "stand in" for a picture, or for that matter, for a concrete object.

It has already been suggested that a model of communication which tends to describe this process primarily or exclusively in terms of "transmission" of information will also be inclined to ignore or discount the differences between iconic and verbal signs and to treat all alike as though they were merely "linear." There is much to be said for the simplicity of such a model, as well as its applicability to much of what occurs in human communication. Such an approach to communication appears to have a good deal in common with the psychophysical and other "extroverted" (3) theories of perception, in that the emphasis in both instances is upon the dominant effect and uniform results of the "external" factors or "given" information that impinges upon the receiver or perceiver. Arnheim has described the "extroverted" psychologists (and philosophers) as those who believe that "--man functions under the impact of the outer world and that his ways of thinking about it and his image of it are dictated by the nature of that outer reality," whereas the "introverted" psychologists are those who "--consider the outer world amorphous," and believe that "--order, character, and lawfulness are imposed upon it by a mind stocked with ideas which are inborn, inbuilt, or adopted from other minds" (3:11). This terminological distinction is provocative, and provides a way to think about theories of perception. But there is a kind of futility in arguing the relative merits of the "external" stimulus as opposed to "internal" structuring of perceptual behavior; almost everyone seems to agree that both locii of control must be taken into account. After this argument has occurred, the choice of emphasis or relative weighting of external and internal factors may provide a convenient way of classifying perceptual theories, but something more is needed, it seems, to explain why some theorists lean in one direction, some in the other.

A great deal of human experience and communication is constituted of information which is merely passed on, or transmitted, in the sense that the receiver/perceiver has a pre-arranged and highly predictable response as to the sense of the item of information or the message. The predictability of response to a sign stimulus is increased when the sign occurs as a "linear " item in the grammatical context of a verbal statement. An "extroverted" theory of perception is appropriate when dealing with such experience or such aspects of communication. When dealing with iconic signs, the "extroverted" theorist is concerned with factors that make responses to such signs reliable or highly predictable. Thus, predictability of response in the case of "realistic" iconic signs is sought by contriving a "surrogate" stimulus that will reflect a sheaf of light rays to a given point which is closely similar or identical to that reflected by the original object, for which the iconic or pictorial stimulus is a surrogate. However, "realistic" signs may give rise to divergent responses. So, if we want a "univocal" or highly predictable response it is best to strip the iconic sign of some of its realistic details and schematize it, in which case it is modified into a quasi-conventional symbol (35).

An "introverted" theory of perception is needed to deal with another large segment of human experience and communication which is constituted of meanings which are not merely given, passed on, or transmitted, but are taken, seized upon, in some part generated by the receiver/perceiver himself. In this arena of perception and communication, the educator is concerned with responses which are not highly reliable, and not necessarily for the sake of increasing reliability of response. He may even wish to encourage divergent responses to the same information, and thus to demonstrate that communication is not merely transmission, that perception is not just the apprehension of some meaning which is antecedently and completely "there," prior to the act of perception itself.

It would be impossible to live at the human level unless a great deal, perhaps the great preponderance, of what is perceived and/or communicated were taken for granted, as given by the source, as categorized and imbedded in the common lingual structure of the culture. It would also be impossible for man to adjust to change, to cope with the new, to expand human knowledge, to grow in understanding unless perceptual and communicative responses were in some degree spontaneous, self-oriented, and thus capable of dealing with the sporadic, the indeterminate, the ambiguous. Perception operates not only in situations that require an answer, but also in those that require the discovery of the question to be answered. The perplexing problem of perception theory is that it must account not only for that which is ordered, settled, determinate, but also that which is indeterminate and contingent.

ADDITIONAL COMMENTS AND CONCLUSION

At considerable risk of oversimplification, an attempt has been made to draw a crude distinction between those theoretical viewpoints that reflect, or lean toward, a rather straightforward S-R orientation, and those that do not. Such an attempt is all the more hazardous since we are dealing with material that is not confined neatly to any single area, but overlaps the fields of learning, perception and communication --not to mention linguistics and philosophy. The S-R paradigm is primarily an artifact of learning theory. Thus, it is somewhat awkward, at least, to use it as suggesting a pattern of behavioral analysis which is also found in some theories of perception and communication. By the same token, the contrasting tendency which has been noted quite loosely as a more "introverted" approach to the study of behavior is nothing more than it purports to be : a crude distinction. A few additional words of explanation may anticipate some unanswered questions, and help to reduce possible misinterpretations of the intent of this analysis.

While I have confined discussion of examples of research and theory to the recent literature, I found it necessary to return to psychophysical perception theory as a baseline for more recent developments explicity related to the subject of iconic signs. A brief reference has been made to transactional theory because it figured prominently in some of the earlier theoretical discussions, and also because it affords the framework of an alternate approach. But I could see nothing to be gained by merely starting the old debate between psychophysical and trans--actional theory all over again. It is worth noting that Gerbner, as early as 1956, proposed a model of communication which dealt explicitly with its perceptual aspect, seeking "to take into account the creative, interactional nature of the perceptual process, avoiding any implications of either solipsism or mechanism" (34:186). In other words, he seemed to say, you don't have to make an "either-or" choice, and of course you don't. This is evident in Gerbner's own statement which appears to constitute a kind of "intermediate" position. But this is not to say that his, or any other third, position is just a mid-point on a scale that reads, "extroverted theory" on one end and "introverted theory" on the other. It is well to remember that we are dealing with a hypothetical "scale" which may, in a sense, have no mid-point. In other words, while we can grade theories as being more or less close to two, antithetical polar positions, it may be that their relative differences are not capable of indefinite shading until one position begins to merge into the other. In still other words, theories are useful for related sets of research problems--and when we are dealing with antithetical theories the related problems may just cluster at the two ends of the hypothetical comparison scale, with little or nothing in between. Thus, one possible third alternative to two polar positions is that the two are both valid and useful, each with respect to its own set of problems. All that remains, then, is to demonstrate that the research interests in both instances are not trivial, and that they actually lend themselves to experimental investigation.

A major conclusion to be drawn from the foregoing analysis is that the development of a theory of iconic signs can draw profitably from sources in the behavioristic tradition that tend to emphasize the S-R paradigm, and also from sources that place more emphasis upon "internal" factors that enter into perceptual-cognitive and communicative processes. Since a great deal of the audiovisual literature, and the great preponderance of research to date, has been developed in an "extroverted" theoretical framework, I have tried to point to other, and still largely unexplored resources for the development of a theory of iconic signs.

There can be no question of the need to explore the tremendous potential of iconic signs as stimuli which can be relied upon to produce desired responses, or as surrogates, to help in the conditioning of behavior to nonverbal objects or events not present to the learning situation. The possibilities of both sorts are almost endless, and they lend themselves readily to an empirical approach, which, as a number of psychologists have pointed out, does not require a special or highly developed set of "audiovisual" or "iconic" principles. VanderMeer (85,86) has demonstrated very nicely how pictorial-verbal presentation (in filmstrips) can be improved by an empirical trial-and-test method, starting from hypotheses intuitively derived--also, incidentally that some of the most plausible "hunches" don't always "pan out." This is a method that could be employed beneficially in the course of production of films and a variety of other audiovisual materials.

As I have already suggested, there is also a need to explore the potential of iconic (and other) signs in more open-ended types of behavioral processes where the problem is not so much to elicit a known and desired response, nor to condition behavior to a given stimulus event--but to help the learner creatively construct a response--which effort, in part, constitutes its own stimulus. The unique value of the iconic sign in this regard may be considered to be its plasticity, and this, perhaps, is related not so much to what we learn from our perceptions--but how we learn to them.

ANNOTATED BIBLIOGRAPHY

1. Allen, William H. and Stuart M. Cooney. "A Study of the Non-Linearity Variable in Filmic Presentation." (NDEA Title VII Project no. 422) Washington, D. C.: U. S. Office of Education, 1963.

This study was designed primarily to study the effect of "non-linear" presentation of multiple images projected side by side, at the same time. Six motion pictures (filmographs) were prepared in color each representing a combination of the non-linear or linear format with one of three content variables. The three content dimensions emphasized factual treatment in one case, conceptual in another, and a combination of factual and conceptual in the third. All films were shown at two grade levels: six and eight. Thus, the experimental variables combined in a 2x3x2 factorial design. On the basis of their statistical analysis of test results, the authors concluded that teaching the subject matter they used (flow charting for computer programming) to sixth graders could be accomplished best in the linear format for factual treatment, non-linear for a mixture of factual and conceptual treatment. They concluded, further, that students at this grade level do not learn or retain the subject matter well when it is treated conceptually in either linear or non-linear format. Differences in format did not produce statistically significant effects in the learning of eight grade students with any of the three different ways of treating the content. However, in their discussion of results Allen and Cooney expressed a degree of satisfaction with the non-linear presentation of visual material which exceeded their formal statistical findings. They stressed the fact that differences found between the two formats were due to the visual component only, the scripts having been constant for each of the content pair of films. Their concluding discussion contains a number of suggestions for further experimental efforts which might reveal more of the potential of non-linear design of visual messages in communication.

2. Arbor, Agnes. The Mind and the Eye. London: Cambridge University Press, 1964.

This is essentially a treatise on scientific method focused upon the field of biological research. It is pertinent, here, because of the author's emphasis upon the role of visual perception in the development of scientific knowledge. Rejecting the notion that vision supplies us with pictorial images in the mind which have a literal "correspondent" truth to external objects, Arbor emphasizes the importance of sensory organization and the reciprocal interplay of sense and intellect. Noting that some philosophers have assigned a rather trivial position to the eye (and other senses) as compared with mind, Arbor traces this tradition to Locke's distinction between "primary" and "secondary" qualities of bodies. "Secondary" qualities being derived from the "primary" qualities of solidity, extension, motion or rest, etc., were described by Locke as having only a kind of spurious sensory existence in the observer--not in the object, itself. Arbor feels that this distinction, although no longer an accepted canon of the theory of knowledge, "still haunts philosophic thought, and is in part responsible for the unfortunate prejudice that allows only an inferior status to visual impressions." She stresses the importance to the biologist of the artist's injunction that drawing (or in the broader sense, visual understanding) requires that one learn to see. There is an important difference between the physical scientist who is preoccupied with "the prediction of the unperceived from the perceived," and the biologist who is more concerned with the "visual and conceptual interpretation of the perceived." "In the area of pure morphology, the biological scientist must achieve the goal of natural philosophy which is a "synthesis of intellectualist logic and sensory apprehension."

3. Arnheim, Rudolf. "What Do the Eyes Contribute?" AV Communication Review 10: 10-21; 1962.

Arnheim provides a Gestalist interpretation of the place of perception in human communication and learning. For purposes of philosophic orientation, he aligns Gestalt theory with the "extroverted" psychologists and philosophers who believe that "--man functions under the impact of the outer world and that his ways of thinking about it and his image of it are dictated by the nature of that outer reality," whereas the "introverted" thinkers "--consider the outer world amorphous," and believe that "--order, character, and lawfulness are imposed upon it by a mind stocked with ideas which are inborn, inbuilt, or adopted from other minds."

4. Arnoult, M. D. "A Comparison of Training Methods in the Recognition of Spatial Patterns," in Teaching Machines and Programmed Learning, edited by A. A. Lumsdaine and Robert Glaser (Washington, D. C.: National Education Association, 1960), P. 583. Abstract: Research Report AFPTRC-TN-56-27, Lackland Air Force Base, Texas: Air Force Personnel and Training Center, Feb., 1956.

   In this comparison of the use of constructed and verbal responses in the training of radar bombardiers in the recognition of spatial patterns, the constructed response method was found to be more effective.

5. Barlow, H. B. "Possible Principles Underlying the Transformations of Sensory Messages," in Sensory Communication. (Contributions to the Symposium on Principles of Sensory

Communication, Massachussetts Institute of Technology, 1959, Edited by W. A. Rosenblith) New York: M.I.T. Press and John Wiley and Sons, 1961.

This is a discussion of three hypotheses regarding the functions of sensory relays, or sensory integration. Specific classes of stimuli act as "releasers" and evoke specific responses. Such stimuli ar treated as "pas swords," and their detection is an important function of sensory relays. The acceptance ore rejection of messages may be controlled by feedback from higher centers changing the transmission characteristics of the sensory pathway. Sensory relays try to ensure that what they pass on really is "news." Reduction of redundancy is an important operation in the handling of sensory information.

6. Behling, Orlando Charles. "Television Analysis of the Behavioral Aspects of Tool-Using." *Dissertation Abstracts* 22:922; (Abstract: Ph.D. Dissertation, University of Wisconsin, 1961).

This study included two experiments to determine the effects of (a) source of visual feed-back cues, and (b) visual orientation in learning "a simple tool-using task," actually a handwriting task. Visual cues were controlled by the use of a closed-circuit television system. In one experiment the subject performs under three conditions: In one he sees both his hand and the graphic trace made as he writes; in the second, he sees only the hand; in the third, he sees only the graphite trace. Quality and speed of writing did not vary significantly with these changes of visual cues. In the second experiment, however, it was found that speed and quality of writing did vary significantly with changes in visual orientation.

7. Bierman, Arthur K. "That There are No Iconic Signs." Philosophy and Phenomenological Research 23:243-249; December, 1962.

Iconic signs dispence with connotation. Following Morris, Bierman points out that the semantic role of icons is not a connotational phase but that they denote the objects which have the characteristics they themselves have--or more usually, a certain specified set of their characteristics. Hence, iconic signs lack connotation.

Bierman argues there are no iconic signs at all because there are no signs whose denotation and signification depend solely upon their resemblance to what they denote. Some signs do resemble their referants, but resemblance is not the basis for the object being a sign.

8. Birdwhistell, Ray L. Introduction to Kinesics: An Annotation System for Analysis of Body Motion and Gesture. Louisville, Kentucky: University of Louisville, 1952.

Kinesics or "social kinesiology" is described as the study of body motions, including gesture and facial expressions, as related to social performance, and especially communication. Body movements, carefully recorded and described, accompanied by physio--logical data, and properly interpreted in a cultural context, may be profitably analyzed as an accompanying or contextual element to verbal behavior in human communication. This publication deals primarily with the description of the notational system which consists mainly of iconic symbols ("kines") representing elements of position, motion, or expression of the various parts of the body. These symbols are used as a kind of pictorial shorthand for recording observations.

9. Black, Harvey B. "Improving the Programming of Complex Pictorial Materials: Discrimination Learning as Affected by Prior Exposure to and Relevance of Components of the Figural Discriminanda." (NDEA Title VII Report, Project No. 688) Washington, D. C.: U. S. Office of Education, 1962.

The object of this study was to determine the effects of quantitative variation of relevant and irrelevant cues in the discrimination of complex visual forms--also the effect of prior exposure. The stimuli used consisted of figures mathematically produced by connecting with straight lines a number of points randomly selected from a 16 x 16 matrix. In other words, these were "random" figures without meaning aside from their accidental geometric properties. Variations on three "prototype" figures were produced by random methods, and the hypothesis that discrimination of figures would be facilitated by the number of such variations, or relevant cues, presented in each figure was confirmed, using analysis of variance of data obtained from the discrimination performance of high school students exposed to the figures. A second hypothesis, that discrimination would be adversely affected by the number of invariant or irrelevant cues was also confirmed; but the third hypothesis, that prior exposure to the figures to be discriminated would improve performance was not supported by the findings.

10. Boulding, Kenneth E. The Image. Ann Arbor, Michigan: The University of Michigan Press, 1963. (copyright, 1956.)

The "image," as Boulding develops the concept, is the functional knowledge that accounts for most human behavior. The individual's image of the world is the sum of his subjective knowledge. It is a cumulative result of past experience, and it is modified continuously as messages from the external world and other human organism impinge upon it.

The image is constituted not only of fact but also of value and emotion. The sensory information that feeds into the growth of the image is filtered through a process of interpretation in which the value system plays an important role.

The image is not related to any physico-chemical structure in a one-to-one fashion--rather, it is conceived in rather abstract terms as an "organic structure" which can be inferred from the behavior of the organism and which follows principles of growth and development similar to those which operate in complex organizations and organisms. Although the very richness of the image of man is a result of its symbolic character, symbols and language cannot fully express it. (However, it should not be confused with an internal visual-iconic image of some sort. It is something much more complex than that.)

A public image exists in the sense that the private images of individuals who share a culture have certain essential features in common. An enormous part of the activity of each society is concerned with the transmission and protection of its public image, but this shared image of the society undergoes changes, too, which conform to the larger growth of organization and society.

Some processes take place in the individual, and in society, which are quite independent of any images held. These are "latent" processes. "Manifest" processes, on the other hand, are those which are brought about or controlled through image, message, and symbol. Boulding acknowledges the expanded image brought about through modern science which seems to auger an age in which man will exercise increasing control over his own destiny, but he has reservations concerning the notion that man could or should attempt to make completely manifest all the processes of history. He urges a sense of humility. We should expand the frontiers of human knowledge but not lose sight of uncertainty and human fallibility.

Boulding suggests that we may be about to witness a profound reorganization of the departmental structure of knowledge and academic life. He proposes that a good deal of work now going on is concerned with the nature of the image, in one way or another. He suggests that a deliberate attempt to focus the efforts of various disciplines upon the problem of the image (a new science of "eiconics") would provide a means of integrating the intellectual work now going on in the several fields of inquiry, and could result in a useful restructuring of the universe of knowledge.

11. Broadbent, D. E. Perception and Communication. New York: Pergamon Press, 1958.

This book is of interest, here, because of its connection with the recent experimental work of Travers (discussed in the analysis), but also because of Broadbent's interest in hearing as opposed to vision. In comparing the two senses, Broadbent notes that of the two "distance" receptors vision is the more highly developed. But the development of vision takes place at an evolutionary level below man, whereas hearing is used for a function more highly developed in man than in the other primates--language. Modern man can read language, of course, but the ear is primary in its development and use. "By studying--the sense with which language is most closely linked, we may help to attack some of the most complex human functions." An even more compelling reason for studying auditory communication is that hearing is especially suited to studies of interaction between two or more stimuli--and Broadbent is concerned with capacity, the quantity of information that can be transmitted through a given channel in a given time.

12. Brown, James W. "A Comparison of Verbal and Projected Verbal-Pictorial Tests as Measures of the Ability to Apply Science Principles." Doctoral dissertation, Department of Education, University of Chicago; 1947. Typed.

Verbal and verbal-pictorial tests were found not to differ significantly in validity and reliability as measures of the ability to apply principles of elementary electricity, as commonly taught in general science classes. However, the verbal-pictorial test tended to provide more reliable predictions of performance ability for lower IQ students. Also, it was found that the two tests differed in validity when the results were analyzed with respect to specific principles, or content. Some of these differences favored one test, some the other, but the study was not designed to provide evidence to explain these differences. Students liked the verbal-pictorial test better than the other, and felt they would remember what they learned from the testing procedure longer.

13. Brown, Roger, Words and Things. Glencoe, Illinois: The Free Press, 1958.

This analysis of human lingual behavior is written from a psychological standpoint, with philosophic overtones. Brown deals with a wide variety of aspects of the subject, ranging from phonetic analysis and description of languages to the problem of reference and meaning--from the psychology of communicative behavior to the development of human speech and the relationship of thought to language.

Discussion of the problem of reference and meaning is particularly relevant to the subject of this bibliography. Brown raises the question, "How are words understood?" which is apparently equivalent to "How do words have meaning?" or "What is meaning?" Among various proposed answers, past and present, he considers and eliminates the following: meaning as a mental image, meaning as a particular response (say, a conditioned response), meaning as an implicit response, meaning as a "mediated" response (Osgood), or fractional response, which is also a type of implicit response. He finds that each of these theories is unsuitable on logical grounds, for lack of empirical evidence, or both. Looking for a theory that will predict overt behavior, Brown proposes that meaning should be described as a behavioral disposition. Understanding is equivalient to a "partial rewiring of the nervous system," which results not in a fixed response or implicit response, but in a disposition to behave in an appropriate manner to lingual stimulation. "The task is not to find the constant reaction that lies behind the varying overt behavior, but rather to find functionally central responses within the overt behavior."

Another theme deserving mention in this context is Brown's postulation that referents of language are categories. Particulars, individual things or objects that might have proper names, are designated as "identity categories."

14. Bruner, J. S., Jacqueline J. Goodnow, and G. A. Austin. A Study of Thinking. New York: Wiley, 1956.

The "attainment of concepts" is the primary concern of this study of the categorizing process. From a psychological standpoint, categories are constructions by which we group the events of the world around us in order to make it "thinkable" and manageable. In this work, the authors are not concerned with the invention of categories but rather with the problem of determining the attribute values by which exemplars can be distinguished from nonexemplars. The reported experimentation deals largely with the strategies typically employed by problem-solvers who are confronted with the task of ascertaining the defining attributes of a concept as they are confronted with a sequence of instances which are known to be positive or negative in each case.

The range of experimental conditions includes "selection strategies" where the problem-solver is allowed to control the order of instances tested, and "reception strategies" where the subjects are obliged to deal with instances presented in an arbitrary order determined by the experimenter. Also included are problems involving conjunctive and disjunctive categories, and categorization with probabilistic cues.

The appendix on "Language and Categories" by Roger W. Brown is, perhaps, more directly related to the subject of this bibliography--especially the part of Brown's discussion dealing with linguistic reference. Brown discounts the notion sometimes used by philosophers and psychologists that linguistic meaning is an image of the referant object. (p. 269) He cites difficulties connected with identifying a proper image for such common nouns as "triangle," "man," or "virtue," also for "identity" categories such as "Ralph Jones." (What view of Jones at what time under what conditions of light, etc.?)

"For a large number of meaningful utterances the ultimate criterion of understanding is the ability to use the utterance to name entities of the category identified. Reports of imagery do not reliably predict this ability and so we abjure imagined meaning and rely entirely on naming behavior as evidence of linguistic understanding---."

Naming behavior, while not the only reliable evidence of meaning, is often a valid sign that the subject has the category in question. Also the meaningful utterance can function as an attribute of the category to be acquired. The name is an attribute of a nonlinguistic aategory "since instances of the nonlinguistic category have the property of evoking the name." p. 284

Speech provides us with an "economical" way of categorizing the nonlinguistic world (p. 287ff.). Indeed, a particlity for linguistic cues in the formation of concepts is a kind of strategy which can maximize information, decrease cognitive strain, and regulate risk (p.289). Language can be used as a substitute for the attributes of the nonlinguistic world where this is more convenient, economical, safer, etc. Within certain limits, the meaning of words can also be derived from the verbal context.

15. Buswell, Guy T. How People Look at Pictures. Chicago: University of Chicago Press, 1935.

This well known study involved the photographic recording of eye movements of 200 persons as they looked at a series of 55 pictures. Analysis of the data suggested two general patterns of pictorial observation: a general survey and a more detailed study. Differences in durations of fixations and pattern were related more to characteristics of individuals than to pictures observed. Such factors as art training, age and nationality did not produce significant differences.

16. Carpenter, C. R. "A Theoretical Orientation for Instructional Film Research." AV Communication Review 1:38-51: Winter, 1953.

This statement, prepared during the period when the author served as Director of the Instructional Film Research Program at Pennsylvania State University, deals with some of the hypotheses involved in that important experimental effort. Of the eight hypotheses discussed, the first four dealing with sign similarity, the function of signs as "releasor-organizers" of responses, channel capacitance, and "perceptual reinforcement," are perhaps most relevant to the subject of this bibliography. Carpenter may have been the first to introduce the term, "iconicity," into the discussion of audiovisual research. The sign similarity hypothesis was that, "Films whose signals, signs, and symbols have high degrees of similarity ("iconicity") to the objects and situations they represent will be more effective for most instructional purposes than films whose signals, signs, and symbols have low degrees of "iconicity." This suggests an approach to the study of iconic signs reflecting the traditional audiovisual emphasis on realism, and also consistent with later efforts to cast the role of pictorial signs in terms of the S-R paradigm. But it should be noted that other hypotheses in the same discussion emphasize the personal life history of the viewer, personal needs, and other factors that give rise to variant responses in the presence of a constant stimulus-event. Also interesting is the discussion of channel capacity and the related experimental work dealing with the effect of varying the level of verbal commentary in a film--as foreshadowing some of the more recent work of Robert M. W. Travers.

17. Carroll, John B. Language and Thought. Englewood Cliffs, New Jersey: Prentice-Hall, 1964.

Deals with the nature, structure, and functions of language and its relations to cognition and thinking.

Chapter III, dealing with the learning of language, and Chapters VI and VII, dealing with cognitive behavior and concepts, have implications for a theory of iconic signs. A section on the role of language in cognitive development (Chapter VII) suggests important questions regarding the related functions of perceptual experience and iconic signs.

18. Cobin, Martin T. and Charles J. McIntyre. "The Development and Application of a New Method to Test the Relative Effectiveness of Specific Visual Production Techniques for Instructional Television." (NDEA Title VII Project no. 448) Washington D. C.: U. S. Office of Education, 1961.

The experimental arrangement involved a closed-circuit television system with two cameras, the output of which could be fed to all receivers on the circuit, or divided between sets of receivers so that some viewers would see one picture and some another, at the same time. The subjects were 310 students taking a course in oral interpretation at the University of Illinois. The students were split into two viewing groups by random assignment and exposed to contrasting video treatments and production techniques in order to measure the effects of some 24 variables. The statistical analysis (by T tests, Chi-Square and analysis of variance) revealed significant differences in learning and attitude response with respect to some of the variables, notably in six out of nine "pure test comparisons" where the variables were not linked with the instructional outcomes sought in the course. Some of the statistical differences disappeared when the variable under scrutiny functioned in the context of a regular instructional presentation--an effect which the investigators thought might be a function of the instructional testing procedures used.

(Comment: This is another example of the empirical approach to the development of visual presentations. The authors express the hope that such empirical methods might generate "data-based theory" but no attempt was made to develop theory here.)

19. Cobun, Ted Charles, "The Relative Effectiveness of Three Levels of Pictorial Presentation of Biological Subject Matter on the Associative Learning of Nomenclature by Sixth Grade Students." Doctoral dissertation, School of Education, Indiana University, Bloomington; 1961. Typed.

Sixth-grade students were tested for the associative learning of biological terms naming the various anatomical structures of a fish following exposure to three pictorial methods for presenting the information. The comparison involved photographs, perspective drawings, and outline diagrams, each chosen to represent different levels on an abstract-concrete continuum. The terms to be learned were introduced as verbal labels on the pictorial presentation. The level of pictorial presentation had no significant effect on the total post-test scores, or retention test administered three weeks after the initial presentation. However, it was found that the mode of pictorial presentation produced significant effects in interaction with the type of material shown. On post-tests given immediately after the teaching presentation students recalled more terms relating to the external anatomy and excised food processing system when these were shown by outline diagram. On the other hand, photographic presentation resulted in significantly better scores relating to the "internals" of the specimen. These differences dropped below the level of significance on the retention test administered three weeks after the initial presentation of materials.

20. Conant, James B. "The Changing Scientific Scene, 1900-1950." The Limits of Language (Walker Gibson, editor) New York: Hill and Wang, 1962.

Conant challenges the analogy frequently drawn between the scientist and the map-maker. Contemporary science is not a process of discovery which reveals the outlines of the universe a little at a time.

Scientific theory is not a description of reality but rather a policy for experimentation. The function of theory is not to tell us what the universe "really is," but rather to "suggest, stimulate, and direct experiment." The primary measure of the value of scientific theory is fruitfulness, not some presumed and final correspondence with reality.

21. Culbertson, Hugh M. and Richard D. Powers. "A Study of Graph Comprehension Difficulties." AV Communication Review 7:97-110; Spring, 1959.

Three hundred fifty college and high school students were given tests to measure their comprehension of information presented by various graphs. Test scores were used to identify elements of graph design that produced the best results. Aptitude scores for college students and IQ scores for high school students were found to be positively correlated with graph reading ability in general.

22. Curl, David H. "An Exploratory Study of a Self-Instructional Method for Teaching Equipment Operation." Dissertation Abstracts 22:815; (Abstract: Ed.D. dissertation, Indiana University, 1961).

This study involved an attempt to measure the relative effect of verbal as opposed to pictorial cues in learning to operate equipment, using a self-instructional method. Task performance did not vary significantly with the type of cue used. Also, other factors such as English comprehension, previous task experience or aptitude scores were not good predictors of task performance.

23. Davidon, Robert S. "Learning in an Object-Grouping Experiment." Perceptual and Motor Skills 6:241-244; 1956.

Two groups of college students were asked to group a common set of objects into as many groups as possible. One group saw the objects depicted as pictures; the other worked from corresponding names. The students who grouped with names had fewer groups, but the groups contained more objects. When the experiment was repeated after an interval of a week, all students formed more groups in the second session.

24. Davidon, Robert S. and Nicholas Longo. "Conceptual Development Reflected in Age Differences in Associations to Names and Pictures of Objects," Journal of Genetic Psychology 96:85-92; March, 1960.

This article describes an experiment based upon the assumption that free association may be used to elicit responses that throw light upon certain aspects of conceptual development as related to age. Three groups of students at elementary, secondary and college levels, equated for IQ and socio-economic status, were exposed to a series of words and pictures of common objects. Responses were analyzed with respect to rate and heterogeneity of association. Older students reacted more quickly. Also, it was found that pictures elicited somewhat faster associations than words, especially with the younger students. Contrary to the authors' expectations, the heterogeneity of associations was as great for words as for pictures, and the variety of responses (to either pictures or words) did not increase with age. Associations based upon contiguity were most common for the college students, whereas the youngest students tended to make responses based upon the function of the named or pictured object.

25. De La Mare, Gwynneth and J. Walker, "The Visibility of Direction Indicators." Ergonomics 5:573-579; 1962.

This study is unusual in that it deals with direction indicators, a class of signs included in the more general category that Charles Peirce called, "indices." Using college students as subjects, an attempt was made to compare the visibility distances of arrow-shaped indicators of varying design. It was found that a simple shafted arrow is more legible than other kinds of indicators, and that, in general, the arrow's design is an important determinant of visibility.

26. Dewey, John. How We Think. New York: D. C. Heath and Co., 1933.

This well known book, written primarily for teachers, contains a number of passages on the place that observation and concrete sensory experience play in reflective thought. Dewey was critical of what he considered to be an over-emphasis on object lessons and sense training when these were not used to illuminate mental operations or create new meanings. On the other hand, his entire treatment of the subject provides constant reminders that thought is about, and is ultimately grounded or tested in, a world of concrete things and objects. An exaggerated emphasis upon the mechanical mastery of verbal symbols is an educational evil. Its polar opposite is observation for the sake of observation, or isolated "sense-training," without regard to a context of purposeful inquiry.

27. Dewey, John. Logic: The Theory of Inquiry. New York: Henry Holt and Co., 1938.

Dewey viewed logic as a progressive discipline, not capable of final formulation. Its subject matter is determined by the operations of inquiry which are of two sorts: those performed on existential material, and those performed with and upon symbols. The symbols in the latter case stand for possible final existential conditions--or serve as a pre-condition for further operations that deal with existences.

Logical forms are postulational. Inquiry has to satisfy certain demands that are capable of formal statement. Some believe that these demands subsist prior to, and independently of, inquiry. Dewey's view was that these formal (logical) conditions of inquiry are postulational--discovered in the course of inquiry and asserted as conditions which further inquiry must satisfy if it is to yield warranted conclusions.

The philosophic attitude represented by this book has a bearing upon the function of verbal symbols, and thus, also, with regard to the nature of iconic signs.

28. Fleming, Malcolm Lee. "An Experimental Exploration of Three Communicator-Strategies for Increasing the Predictability of Pictorial Cue: Verbal Response Relationships." Doctoral dissertation, Indiana University, Bloominton, 1960. Typed.

This is an exploratory study concerned with the general problem of designing pictorial messages so as to produce highly predictable responses. The starting assumption is that verbal responses can be controlled by strategies for the selection and ordering of attributes of the pictorial stimuli to which the responses are made. The measure of control selected

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for the purpose of this experiment is the position of responses on a concrete-to-abstract scale. Three hypotheses were tested, each representing a different strategy: (1) As the number of attributes of a single picture are reduced, the responses tend to become more abstract, (2) When a pair of objects is shown, the responses tend to become more abstract as the number of attributes common to both members of the pair is reduced, (3) The class of verbal response to a pair of pictured objects will be positively related to the object category, itself; to its abstract geometrical form; or to number; depending upon which set of relevant attributes has been made most "available." Slides were prepared according to the specifications of the three strategies, and these were shown to subjects who were asked to make free naming responses, and also to register fixed alternative responses in a multiple-choice format to each picture. Statistical analysis of the results resulted in confirmation of all three hypotheses at high levels of confidence.

29. Fonsecá, Luiz and Bryant Kearl. "Comprehension of Pictorial Symbols: an Experiment in Rural Brazil." Bulletin 30 (Madison, Wisconsin: University of Wisconsin, College of Agriculture, April, 1960).

A major hypothesis of this study was that the capacity to interpret pictorial symbols is a function of learning. It was found that young, illiterate subjects, or those with limited schooling were significantly inferior to older, better educated subjects in interpreting pictorial symbols. Comprehension of pictures was reduced by excessive or insufficient detail, unfamiliar subject matter, use of single picture to show a process requiring several steps, and by fanciful treatment.

30. Gaeth, John H. "Verbal and Nonverbal Learning in Children, Including those with Hearing Losses." (Cooperative Research Project no. 1001) Washington D. C.: U. S. Office of Education, 1963.

In a series of experiments subjects were exposed to a various kind of stimuli used in a paired-associate learning task. The stimuli included various combinations of verbal, non-verbal, meaningful and non-meaningful materials, presented singly and also in bi-modal or "audio-visual" combinations. It should be noted that the non-verbal stimuli were non-iconic, and that "audio-visual," here, means simply a bi-sensory combination of visual and auditory stimuli. In general, the study found that "meaningfulness" facilitated learning most and that other variables were not significant, including the combined "audio-visual" presentation versus one which involved only one sensory mode.

This study is a good example of the case where semantic difficulties arise through a perfectly legitimate but unfortunate use of the terms "nonverbal" and "audio-visual." The fact that the nonverbal materials used were exclusively non-iconic and "meaningless" has to be emphasized. Also, that the bi-modal or "audio-visual" presentations were either tantologous or combined "message" elements in a mechanical and meaningless way needs to be emphasized. Not that the findings of the study are unimportant. They are most interesting, and all the more so where they are negative.

31. Gamble, Rondal Ross. "An Experimental Study Using Semi-Concrete and Abstract Materials in a Paired-Association Learning Task." Dissertation Abstracts 24:1072-1073; (Abstract: Ph.D. dissertation, University of Oklahoma, 1963).

This study was conducted to determine the comparative effect of two types of material on the learning rates of bright, normal and retarded high school students in a paired-associate learning task. One set of items (semi-concrete) consisted of outline drawings of common objects, but these were paired so as to avoid coupling commonly associated objects. The other set of items (abstract) consisted of meaningless lines of different configurations. Analysis of the results revealed that bright students learned both types of materials more rapidly and accurately than did normal or retarded students, but the type of material used produced no statistically significant differences in learning rates for any of the categories of students represented in the study.

32. Garner, W. R. "To Perceive is to Know." _American Psychologist_ 21:11-19; January, 1966.

Describes experiments from which the author draws the inferences: (a) perception is a cognitive process--to perceive is to know, (b) the factors known in perception are the properties of _sets_ of stimuli, (c) the perceiver actively selects the structure to which he will attend and react. On occasion, he may even provide the structure.

"To perceive is to know the nature of a stimulus, the nature of the alternatives, to know the structure and organization of sets of stimuli--of which the stimulus perceived is a member of a sub-set." "The subject actively participates in the perceptual process by forming sets and sub-sets of stimuli, and his perception of the individual stimulus is really perception of the properties of these sets."

33. Gatzy, John Thomas. _The Relationship of Visual-Auditory Perception to Grade Placement of Sound Motion_

Picture Films. Ed. D. dissertation, Rutgers University, 1946.

Among other findings, this study revealed that older junior high school students see and comprehend more of the film content of sound motion picture films in science than do younger ones. Also the gains obtained on repeated showings tended to be greatest in the highest grade (10). While not surprising, these results are useful in that they suggest that perceptual discrimination abilities, as well as lingual ability, vary perceptibly with age, even within a short span.

34. Gerbner, George. "Toward A General Model of Communication." AV Communication Review 4:171-99; Summer, 1956.

This compact, but comprehensive, discussion of communication theory is of interest, here, primarily because of the explicit attention given to perception as a factor in the communication process; also because the discussion of perception makes reference to other attempts to relate perception theory to audiovisual communication.

35. Gibson, James J. "A Theory of Pictorial Perception." AV Communication Review 2:3-23; Winter, 1954.

Pictures are defined as "surrogates" by which perceptions can be mediated when the original object or scene is not present to the perceiver. Surrogates may

be conventional, as in the case of verbal symbols, or replicative, as in the case of pictures. Since replicative surrogates are essentially substitutes for primary experience, fidelity is a matter of primary concern. This is defined in terms of exact geometrical properties of the sheaf of light rays reflected by the picture to a given point, and the correspondence, point by point, to a cross-section of a similar sheaf of light rays from the original object. In the case of a three-dimensional model, Gibson resorts to a somewhat simpler definition of fidelity in terms of direct geometrical correspondence of the object, itself, to the original. Gibson deals with the limitations of fidelity in pictures and cites a number of areas for needed research, including the problem of the "unique viewpoint" of the picture and the effects of deviations from this viewpoint upon mediated perceptions. Passing attention is given to the different functions of conventional and replicative surrogates, as well as "mixed" surrogates which strive for some compromise between the fidelity of realistic pictures and the univocality of conventional surrogates--the one advantage always gained at some expense to the other.

36. Gropper, George L. A Behavioral Analysis of the Role of Visuals in Instruction. Pittsburgh, Pennsylvania: Metropolitan Pittsburgh Educational Television Station

and the American Institute for Research, 1963.

This analysis, based in part upon the results of experimentation conducted by the author in Pittsburgh schools, deals with the problem, "How can nonverbal visual materials be used to promote the acquisition, retention, and transfer of the responses we define as knowledge?" Using an objective, stimulus-response language, the author is inclined to deal with visuals and alternative verbal stimuli on a rather impartial basis on the grounds that their relative effectiveness under varying conditions of instruction is a question to be settled empirically, at least at this stage of the game. The worth of a visual or any other presentation is determined by requiring the student to make a response (verbal, visual or motor), and then evaluating the tangible, recorded evidence.

The author does, however, provide some theoretical framework. He cites two basic functions of visuals: visuals as cues and reinforcers, and visuals as examples. He also makes a distinction between "criterion" and "intermediary" visuals. Criterion visuals are those that are used to bring particular responses under their control, whereas intermediary visuals are used to cue responses so that control over these responses can be passed to other (usually verbal) stimuli. Other prominant matters in the theoretical discussion include the problem of transfer from one mode of presentation to another, and the potency of visual reinforcement in learning.

37. Guba, Egon, Willavene Wolf, Sybil DeGroot, Manfred Knemeyer, Ralph Van Atta, and Larry Light. "Eye Movements and TV Viewing in Children," Audio-Visual Communication Review 12:386-401; Winter, 1964.

This study involved the use of an apparatus by which eye movements could be recorded as a superimposed pattern on a visual scene simulating a television presentation. The end-product was a motion picture film on which each frame showed the position of an eye marker registered by a corneal-reflection beam on the scene viewed by the subject at that instant. Data were obtained by analysis of the changes in position of the eye marker from frame to frame. The subjects were fifth grade students and the materials viewed were two brief television presentations. It was found that the eyes do tend to focus or "cluster" on certain areas in the visual field, that subjects tend to be preoccupied with the face of the narrator (although this effect is reduced when the narrator is discussing and directing attention to some display), and that there is a high correlation between intelligence and the distribution of different types of eye movements. Variations in the size and shape of the eye marker (termed "blooming") were displayed in large amounts by subjects of lower intelligence. This effect was interpreted as an indication of wandering gaze. The authors expressed the view that "blooming," when better understood might be useful as a possible index of attention. The interesting results of this study seem to indicate that similar techniques could be applied fruitfully to further studies of television viewing as well as motion pictures and other types of visual presentation.

38. Hall, Edward T. The Silent Language. Greenwich, Conn.: Fawcett Publications, 1963. (copyright 1959.)

Writing from an anthropological point of view, Hall documents many of the ways by which human behavior is communicative, other than ordinary speech. Culture is defined as communication broadly conceived. The "vocabulary" of culture is described in terms of a series of ten "primary message systems" which are rooted in biological activities widely shared with other advanced living forms. The tacit, culturally determined, "language" which expresses itself in various "primary message systems" is manifested at various levels, and not only sets limits to the behavior of the individual, but also shapes his view of the world and the behavior of other persons. While this book does not deal with analogical signs in the limited perview of pictorial communication, it does emphasize the degree to which meanings are conveyed by extralingual means and the pervasive force of the behavioral context within which formal lingual expression occurs.

39. Harrison, Randall. "Nonverbal Communication: Explorations into Time, Space, Action and Object," Dimensions of Communications. (J. Campbell and H. Hepler, editors) San Francisco: The Wadsworth Publishing Co., 1964.

Deals with some of the ways in which nonverbal cues affect communication, sometimes at a low level of awareness. After considering the problem of coding nonverbal messages, Harrison considers nonverbal elements involved in the selection, comprehension, acceptance, recall and use of communicated information. Temporal and spatial factors are discussed with regard to the achievement of communication goals. Some differences between analogic and digital coding are described.

40. Harrison, Randall Paul. "Pictic Analysis: Toward a Vocabulary and Syntax for the Pictorial Code: With Research on Facial Communication." Michigan State University, 1964. Doctor's Thesis, Mimeographed.

This study of pictorial communication is focused upon facial expressions and the effects they produce in the communication process. It reflects a broad interest in the development of a pictorial code by which analogic messages or factors in communication could be analyzed. Such analysis, applied to pictures under the suggested name of "pictics" would correspond to linguistics as applied to the study of language, or to "kinesics" as applied to gestural language. The research involved the use of schematic faces ("pictomorphs") constructed from all possible combinations of five eyebrow types, four eye and three mouth types. These combinations resulted in 60 faces each of which was played against a selection of appropriate and non-appropriate adjectives. It was found that some faces and some elements of the schematic facial expressions produced reliable responses. In other words, Harrison found a "vocabulary of facial cues which have predictable meanings for the viewer."

By factor analysis, Harrison found that "we can talk economically about the 60 faces in terms of four factors: happiness, worry, anger, and boredom, or low arousal." A similar analysis of the 70 adjectives available to the viewers for interaction with the faces underlined four factors: approval or acceptance, social-potency, interest, and demographic. He proposed that these findings may suggest avenues for further analysis and exploration of the communication process.

41. Hartman, Frank. "Single and Multiple Channel Communication: A Review of Research and a Proposed Model."

AV Communication Review 9:235-262; November-December, 1961.

This comprehensive review of the research on single and multiple channel communication is combined with discussion of a proposed theoretical model. The review deals with three "channels" which are basic to all current mass media: The pictorial, the auditory verbal and print--and their various combinations. The relative scarcity, as well as certain limitations, of studies dealing with the pictorial channel, as such, were considered to preclude making comparisons between the pictorial and other channels. However, Hartman does suggest that comparisons of pictorial-verbal presentations with single channel presentations strongly indicate advantage for the combination of channels. Users of this bibliography may be particularly interested in the discussion of a "stimulus generalization model" which is related to the notion that," Generalization between two stimuli is a function of the number of cues which they possess in common."

42. Heidbreder, Edna. "The Attainment of Concepts: II The Problem." Journal of General Psychology 35:191-223; October, 1946.

This paper is one of a series which considers the results of experiments conducted by the author in which it was found that subjects "attained" concepts of concrete objects, spatial forms, and numbers in that order. The experiments involved learning nonsense names for pictures representing instances of the three classes of concepts, and comparisons of the relative number of trials required to attain the several concepts. The findings are explained on the basis of Heidbreider's hypothesis that the perception of concrete objects is the dominant mode of human cognitive reaction. See Heidbreider, "Toward a Dynamic Phychology of Cognition." (Next entree.)

43. Heidbreder, Edna, "Toward a Dynamic Psychology of Cognition." The Psychological Review 52:1-22; January, 1945

As a basic hypothesis, Heidbreder proposed that the typical and dominant cognitive response is the perception of concrete object; all other cognitive responses may be regarded as in some sense approximations to, or modifications of, this form. The distinctive cognitive response in human behavior involves the attainment of concepts, and this is a modified form of the perception of objects. The dominance of perception of concrete objects is attributed to the evolutionary state of the human species, as a highly manipulative organism. Although conception goes beyond the concrete aspect of experience, there is nothing in cognition which is not in perception. To perceive invariably involves a construct. No reaction is purely perceptual or purely conceptual; nor, for that matter, merely cognitive. However, conception involves a radically different mode of organization, including the use of symbols. Human behavior is such that we tend to cling to the perceptions of concrete objects, and withdraw reluctantly to more abstract reactions.

There is also a tendency to return to some concrete resolution of a cognitive problem even when this is unnecessary or undesirable, as evidenced by the gratuitous reification of abstract concepts in theoretical operations.

44. Hickey, Albert E., William J. Laidlaw, Harvey A. Taub, John M. Newton and Warren H. Teichner, "Requirements for Graphic Teaching Machines." (NDEA Title VII Project no. 899) Washington D. C.: U. S. Office of Education, 1962.

Part I of this study involved a content analysis of the use of graphic stimuli in high school textbooks in algebra, biology and music. Stimuli were classified in terms of 30 categories, and responses (called for) were analyzed into 16 categories, thus producing a grid of 480 cells in which each cell represented a possible stimulus-response combination. Using this, it was possible to tabulate data revealing what kinds of stimuli (whether graphic or not) were used to elicit or prepare the responses called for in exercises at the ends of chapters. From this analysis of sample pages the authors drew the conclusion that, with the exception of music, "graphics were used in the sample textbooks not as primary communications, but only as secondary elaborations of verbal and numeric stimuli and responses." (p. 19)

Part II reports the results of a series of experiments to compare the effectiveness of the use of "graphic" and "symbolic" modes in teaching Boolean algebra. This subject matter was selected for the study because the same content material could be presented in two equivalent forms: circuit diagrams, and the more conventional mathematical equations. Neither form of presentation proved consistently superior to the other. There was positive transfer when students were switched from one mode to the other. Also, performance was better when translating from either graphic or symbolic presentation to verbal response, as opposed to translating from verbal presentation to graphic or symbolic response.

The optical and mechanical requirements for graphic teaching machines were reviewed in an appendix to the report.

Although there is a degree of iconicity in the circuit diagrams of Boolean algebra, such diagrams represent a rather highly formalized type of graphic symbol, which, in a sense, is closer to the "pure" arbitrary symbol than the realistic analogical sign. Generalizations from this study should take this observation into account.

45. Hilgard, Ernest R. "Learning Theory and Its Applications," New Teaching Aids (Wilbur Schramm, editor) Stanford: The Institute for Communication Research, 1960.

Although not directly pertinent to the subject of iconic signs, this discussion of the application of theory, and the need of a theory of application, is most suggestive to anyone interested in instructional research. Substantive findings suitable for application are drawn from S-R theory, cognitive theory, and personality theory. Hilgard notes that applicable findings from cognitive theory are relatively difficult to specify--an observation that also seems to apply to the area of iconic signs (as employed in teaching) when viewed from a perspective other than the S-R point of view.

46. Hoban, Charles F. Jr. Focus on Learning: Motion Pictures in the School. Washington D. C.: American Council on Education, 1942.

This well known publication is one of the earlier works in the audiovisual field dealing specifically with the functions of pictures. Pictures can be Used to show what something looks like, how something works, or how something happens. The motion picture is unique in its capacity to portray action, and thus show how something happens.

The question whether pupils learn more from films than from books cannot be answered because it is not a valid question. Pictures have one role and words another. Hoban also discusses the related functions of pictures and words in films. In an interesting foreshadowing of Travers' experimental work, this book suggests that density of information in either the visual or sound track of a motion picture may result in competition, or interference of one track with the other.

47. Hoban, Charles F. "The Usable Residue of Educational Film Research," New Teaching Aids (Wilbur Schramm, editor) Stanford: The Institute for Communication Research, 1960.

With respect to the functions of pictures and language, Hoban points out that most film research during the 1930's was "device-determined," and that studies since then have shed very little light on the "differential and interacting roles of pictures and language in films."

48. Hoban, Charles F., Charles F. Hoban Jr., Samuel B. Zisman. Visualizing the Curriculum. New York: The Dryden Press, Inc., 1937.

In this early audiovisual publication, the authors described the educational fault of "verbalism" as "the use of words without appreciation of the meaningful content of the words or of the meaningful content of the context in which they are used." (p. 3) They argued that if school instruction was to become more meaningful, visual aids should be used "to enrich and vary the pupil's concrete experience." (p. 9) In an outline of general principles underlying the use of visual aids, the authors proposed that the value of visual aids depends upon their "degree of reality" and the nature and extent of the pupil's previous experience. (pp. 22-23) Visual aids are effective in instruction to the degree that they approach reality of experience. Moreover, the reality depicted must be subjectively valid to the pupil. However, the need for concrete instructional materials varies with the previous experience and maturity of the learner. "If varied experience has already developed wide and manifold differentiation and integration from the concrete through the intermediate levels of experience to the meaningful use of words (verbalization), further visual aids are unnecessary for the development of progressive abstraction." (p. 23)

49. Hochberg, Julian. "The Psychophysics of Pictorial Perception." AV Communication Review 10: 22-54; 1962.

This is a thorough and highly informative discussion of psychophysical theory as applied to the specification of stimulus variables that control our perceptions of pictures. Included are such matters as what constitutes an edge, what makes a figure look solid, "laws of organization" that structure our perceptions, what governs where we look in a visual display, etc. Our knowledge of these matters is still very limited, and much research remains to be done.

50. Hunter, Walter S. "Visually Controlled Learning as a Function of Time and Intesnsity of Stimulation." Journal of Experimental Psychology 31:423-429; 1943.

This study bears out the plausible hypothesis that the time required to encompass or "learn" the information in a display is a function of (a) the complexity or quantity of information it contains, and (b) the degree of intensity of stimulation. The stimulus material consisted of eighteen clusters of dots, each one containing a different number in the series, 1-18. A single trained subject was shown a given number of dots repeatedly, for specific intervals of time, and at specific intensities of illumination, until she had "learned" and reported the number of dots, in each case. The data analysis indicated that as the material to be "learned" increased there was a linear increase in the log of the number of presentations required. More exposures were also required as the intensity of stimulation was decreased.

51. Karwoski, T. F., F. W. Gramlich, and P. Arnott. "Psychological Studies in Semantics: I. Free Association Reactions to Words, Drawings, and Objects." The Journal of Social Psychology 20:233-247; November, 1944.

This free association experiment was designed to explore differences in reactions to common objects, drawings (of the same objects), and words naming the objects. Analyses were made to determine the overall distribution of responses at the verbal, pictorial and object levels, and also the distribution of responses in terms of a logical classification. In general, the order of distribution of responses in terms of logical type were the same for all three levels of stimuli. A conspicuous finding was that objects and pictures tend to call for "operational" responses related to the function or use of the object, whereas words call forth more responses having to do with related objects--also more phrase-completion and "clang" responses. Reaction-time to words was somewhat shorter than to objects and pictures.

52. Kefkowith, Edwin F. "The Validity of Pictorial Tests and Their Interaction with Audio-Visual Teaching Methods." (Technical Report, SDC 269-7-49) Instructional Film Research Reports, v. 2 SDC 269-7-61. Port Washington, N. Y.: U. S. Naval Training Device Center, 1956.

A study of the interaction of teaching and testing methods. Two teaching methods were used in the instruction of recruits in the function and nomenclature of equipment: black and white photographs and outline drawings. The difference was in their degree of iconicity of similarity to the actual equipment. Three testing methods were used: identification by means of the actual equipment, by black and white photographs or by outline drawings. Combinations of the teaching and testing methods were compared. Test scores were influenced by the degree of iconicity between testing and teaching pictorial stimuli. Testing methods were most valid when pictorial stimuli were most like those used in teaching.

53. Kendler, Howard H. "Stimulus Response Psychology and Audiovisual Education." AV Communication Review 9:33-41; September, 1961.

This is essentially a statement of the meaning and value of the S-R paradigm as a model of behavior for the study of problems in audiovisual instruction. Noting the trend toward simplicity in experimental design, and the highlighting of the influence of basic variables in the study of learning, Kendler suggests that audiovisual experimentation should follow similar lines--that the problem of the audiovisual educator is essentially one of arranging optimum condtions for the formation of associations between stimuli and responses.

54. Kersh, Bert Y. "Classroom Simulation: A New Dimension in Teacher Education." (NDEA Title VII Project no. 886; U. S. Office of Education) Monmouth, Oregon: Oregon State System of Higher Education, 1963.

Four experimental groups of practice teachers were exposed to an instructional procedure involving the use of a classroom simulator which presented various types of problems or situations that occur, typically, in teaching. The students were allowed to respond to each situation and then witness a simulated reenactment of the student behavior that would presumably result from his instructional decision, in each case. Testing, also conducted in the simulated classroom, revealed that the training procedure successfully taught the students a number of criterion skills and principles for which the simulated incidents had been constructed as test cases. Analysis of results attributed to the mode of simulation indicated that the smaller, less realistic projections of classroom scenes were more effective than life-size sound motion pictures. Also, it was found that learning occurred more quickly during practice trials from still projection than from motion pictures.

55. Ketcham, Carl H. and Robert W. Heath. "Teaching Effectiveness of Sound With Pictures That Do Not Embody the Material Being Taught." AV Communication Review 10: 89-93; March-April, 1962.

In this study four groups of graduate students were taught by four different methods: sound only, sound with relevant pictures, sound with irrelevant pictures, sound with irrelevant pictures and sound with abstract geometric forms. Analysis of post-test scores revealed that sound with relevant pictures was the most effective method, followed by sound only--whereas sound with irrelevant pictures produced the poorest results. The study is of interest because it leads into a relatively unexplored area: what is the effect of visual images linked to auditory instruction by association only?

56. Knowlton, James Q. A Socio-and Psycho-Linguistic Theory of Pictorial Communication. Division of Educational Media and Audio-Visual Center, Indiana University,

Bloomington, Indiana: 1964.

Knowlton finds that research in the area of pictorial communication has not produced satisfactory results because many "audiovisual" studies have failed to give proper attention to the distinction between media and message, or have not dealt explicitly with message characteristics--also because of erroneous assmumptions about the relationships between pictorial and verbal symbols. A particularly important problem, in his view, is that students of pictorial symbols have generally failed to understand that pictorials are "post-linguistic symbols," i.e., that their function of signification of a pictorial symbol depends upon whether the intended concept has already been attained by the interpreter--this primarily a linguistic accomplishment. Knowlton outlines a metalanguage for discussing the features and relative values of lingual and iconic signs. The referents of signs are categories, or concepts. Recent studies by Bruner and others are cited to show the correlation that exists between categorizing or conceptual development and lingual behavior in children. Evidence is cited to show that iconic representation does not necessarily favor logical thinking, may even interfere with it in some cases. Knowlton suggests that only in special sorts of situations should a picture be regarded as having as its primary function that of an iconic sign, or as a substitute for words "in any way at all." Pictures can help primarily in the teaching of words, and thus contribute indirectly to the conceptual development of learners.

On the other hand, language has its distinct limitations. Pictures are uniquely suited to deal with aspects of the world not encoded in language, and also play an important role in inventive behavior.

57. Kopstein, Felix F. and Sol M. Roshal, "Verbal Learning Efficiency as Influenced by the Manipulation of Representational Response Processes: Pictorial-Verbal and Temporal Contiguity Factors." (Chapter 20 in Student Response in Programmed Learning, edited by A. A. Lumsdaine) Washington, D.C.: National Academy of Sciences National Research Council, 1961.

Among other factors considered in this study, a comparison was made between pictorial and verbal stimuli in teaching Russian words to Air Force basic trainees. Significantly higher scores were registered by groups trained with pictorial stimuli.

58. Langer, Susanne K. Philosophy in a New Key. New York: The New American Library of World Literature (Published as a Mentor Book by arrangement with Harvard University Press), 1942, 1955.

Langer proposes the idea that the Cartesian age of mental and natural philosophy is drawing to a close--that the current interest in the philosophical study of symbols marks the rise of a new generative idea, a new intellectual epoch. The empirical scientific method, following the highly successful path of modern physics, has been emulated by the "mental" sciences, but not with comparable results. Langer suggests that the physicist's scheme may actually be blocking progress in the study of humanistic problems. On the other hand, a recent preoccupation with symbols has come into fashion in logic (symbolic logic) and in psychiatry. In the fundamental notion of symbolization we may have the key-note of all humanistic problems, a new generative idea "--to free the deadlocked paradoxes of mind and body, reason and impulse, autonomy and law--." Langer suggests this new method "--will overcome the checkmated arguments of an earlier age by discarding their very idiom and shaping their equivalents in more significant phrase." (p. 19)

Symbolism is the recognized key to the mental life that is human. Man, unlike other animals, uses signs not only to indicate things, but to represent them. However, the evolution of language does not bear out a conventional genetic explanation. Human language is something more than merely the elaboration or development of more primitive animal behavior. Rather it reflects a basic need that is qualitatively unique to human behavior, and which results in a constant process of idealization not primarily practical or utilitarian in nature. It is this process of symbolization which gives rise to language, ritual, myth, art--the whole world of symbolic forms.

Symbolic forms are of two major categories: discursive and presentational. Langer argues that the field of semantics embraces both categories. Language arises out of more primitive forms of behavior--dream, ritual, superstitious fancy--and developes gradually from the common parent stock of both verbal and non-verbal formulation: the basic act of symbolic transformation. Bare, denotative language is the instrument of exact reason--this is its great strength. But language, in a literal capacity is a "stiff and conventional" medium, poorly adapted to the expression of genuinely new ideas, "which usually have to break in upon the mind through some great and bewildering metaphor." Language allows us to analyze experience already presented through some formative medium, "some vehicle of apprehension and memory." But we must have ideas before we can make literal analyses of them, "and really new ideas have their own modes of appearance in the unpredictable creative mind." Science rationalizes myth, but when the ideas of the old myth are totally exploited and exhausted, there will be a new vision, a new mythology.

For an earlier and more comprehensive philosophic discussion of the nature of signs and symbols, the reader should consult the works of Ernst Cassirer.

59. Lumsdaine, A. A "Cue and Response Functions of Pictures and Words." Chapter 10 in Learning From Films. New Haven, Connecticut: Yale University Press, 1958.

In this study of simple rote associative connections, through paired associates, Lumsdaine found that his subjects scored best on picture-word combinations, least well when the order was reversed to word-picture. (Words and pictures were paired on a random basis, without semantic connections.) The findings were statistically reliable, and were consistent under varying conditions. The theoretical assumptions included the following: Close temporal contiguity is the prime condition for forming an association between a stimulus and a response. Pictures make better stimuli for associative learning because a person can look at a picture and say a word at the same time, or at least with the closest temporal contiguity--whereas one cannot say two words at the same time. Words make better response items because they have greater flexibility of meaning than pictures, hence offer a greater range of possible connecting or mediating cues by which they can be associated with a given stimulus. A second advantage of words as response items is that they have minimum equivocality in leading to the desired response. "The naming of a word is much less equivocal than the naming of an object."

60. Lumsdaine, Arthur A. and Mark A. May. "Mass Communication and Educational Media," Annual Review of Psychology, vol. 16. (Paul R. Farnsworth, editor) Palo Alto, Calif., 1965.

The introduction to this survey of recent research points out the disadvantage that the field is defined in terms of presentation mode rather than a more fundamental basis such as stimulus-response terms or underlying psychological processes. However, the authors note in media research a diminution in over-all "gross methods" comparisons, particularly in futile attempts to assess the over-all value of media by comparisons with "conventional" instruction, and a corresponding increase in the proportion of studies which attempt to manipulate specifiable variables.

61. McConnell, Owen Link. "Perceptual and Verbal Mediation in the Concept Learning of Children." Dissertation Abstracts 24:1247-1248; (Abstract: Ph. D. dissertation, Duke University, 1963).

This study involved an attempt to compare the concept learning of younger and older children, with regard to their use of perceptual cues and their preferences for perceptual versus verbal cues when the two sorts are in conflict. Both younger and older children responded "in a mediational manner" to arrangements of perceptual cues, but younger children were more susceptible to the interfering effect of emphasizing an irrelevant dimension (of stimulus) than were the older children. When relevant verbal cues were pitted against irrelevant perceptual cues, the former dominated with older children, the latter with younger children.

62. May, Mark A. and A. A. Lumsdaine. "Patterns of Words and Pictures," Chapter 11 in Learning From Films. New Haven, Connecticut: Yale University Press, 1958.

This study involved an analysis of test items on subject matter covered by instructional motion pictures to determine which parts of the films had produced the best learning results. The study is cited here mainly to direct attention to the method, which, though it seems to have a very promising potential as an exploratory technique (to identify variables which might merit closer study), has not been widely used.

63. Meierhenry, Wesley C. (editor) "Learning Theory and AV Utilization." AV Communication Review; September-October, 1961.

This special issue of AV Communication Review contains a collection of articles by well-known psychologists dealing explicitly with learning theory as applied to audiovisual instruction, and to experimental investigation in this area. The matter of primary interest, here, is the discussion of research methodology as applied to audiovisual instruction, generally.

64. Meierhenry, Wesley C. (editor) "Needed Research in the Introduction and Use of Audiovisual Material: A Special Report." AV Communication Review 10:307-316; November-December, 1962.

This report was prepared by a group of audiovisual specialists and research workers conversant with the audiovisual field and its research, held in Washington, D. C. in May, 1961, with financial support from Teaching Film Custodians, Inc. A list of problems or topics requiring further experimental study and/or theoretical developmental were identified under the headings of (a) learner and media characteristics, (b) extension and verification of theoretical formulations, and (c) equipment, facilities, and dissemination. Of particular interest in the context of this bibliography is the featuring of "media" as the typical experimental variable--the matter of primary experimental and theoretical concern, and the lack of mention of problems having to do with message components. One topic does suggest a study of semantics and related fields as applied to audiovisual research; and several listed items reflect an interest in trying to distinguish between the audio and visual parts of some media presentations. Thus, although in a limited way, this report does suggest the need of making finer experimental and theoretical discriminations than the media, themselves.

65. Miller, George A., Eugene Galanter, and Karl H. Pribram. Plans and the Structure of Behavior. New York: Henry Holt and Co., 1960.

This original and provocative volume proposes a "cognitive" approach to the study of human behavior based upon the concept of a feedback loop (TOTE unit) rather than the traditional reflex arc. The authors argue that the concepts of stimulus and response, as used by many psychologists, require redefinition as contemporaneous and correlative events. They acknowledge their debt to John Dewey, whose psychology followed similar lines as early as 1896, but their thesis takes on a modern aspect through their discussion of behavior as an information processing system which can be simulated in at least some respects by the operation of electronic computers. Their theory revolves around the central concepts of the Image (not unlike Kenneth E. Bouldings development of the same idea) and Plans, which are like computer programs, and are derived from the Image. Plans consist of, and operate as, TOTE units and are organized in hierarchical systems. The authors feel that human behavior can be described as the formation and running off of plans.

This book does not deal explicitly with the problem of perceptions as involved in non-verbal communication, but it contains some interesting suggestions regarding the relationship of digital and analogue processes as involved in some hierarchical structures of plans. The authors suggest that the development of a skill may have an effect similar to providing a digital-to-analogue converter at the output of a digital computing machine. They also suggest, but do not discuss, the idea that the perceptual mechanism may provide an analogue-to-digital input for the higher mental processes.

66. Miller, Neal (editor). Graphic Communication and the Crisis in Education. (A special issue of AV Communication Review, Vol. 5, No. 3.) Washington, D.C.: Department of Audio-Visual Instruction, National Education Association, 1957.

The second of the two parts of this publication deals with principles involved in learning from motion pictures or other graphic instructional materials. Starting with the observation that there is an apparent need to develop a better theoretical base for the analysis of how people learn from pictures (and words), Miller proposes a formulation in terms of S-R learning theory, with focal regard to the factors of drive, cue, response and reward. A primary consideration with regard to the function (and value) of the realistic pictorial cue has to do with the principle of stimulus-generalization. A response learned to one cue can be elicited by other similar cues; hence the pictorial similarity of a cue to its referent has a distinct meaning in terms of learning theory. Responses learned from a graphic cue may transfer to its referent, and this effect may be facilitated to the extent that the graphic cue is realistic, or similar to its referent. However, this primary orientation is qualified by the observation that some learning situations require selective response to relevant cues or to the general features of a class of objects--in such cases, a cue which has too much specificity or "realism" may interfere with efficient learning of the desired response.

67. Morris, Charles. Signs, Language and Behavior. New York: Prentice-Hall, 1946

This well-known book is frequently cited as a source of the term, "iconic sign," defined as a sign that resembles the thing it represents. Morris' discussion follows the earlier work of Charles Peirce on the subject of "icons" and "indices," also cited in this bibliography.

68. Norberg, Kenneth. "Perception Research and Audio-Visual Education." AV Communication Review 1:18-29; 1953.

This article suggested some implications of the transactional approach to the study of perception as related to audiovisual education. Transactional theory proposed that we learn not just from perceptual stimuli, but from the actions that test the assumptions which in part control our perceptions.

69. Norberg, Kenneth (editor). Perception Theory and Audio-Visual Education. (Special issue of AV Communication Review, Vol. 10, No. 5) September-October, 1962.

This special issue of AV Communication Review contains a collection of articles by psychologists on perception theory as related, specifically, to audiovisual instruction. Included among the contributors are Rudolph Arnheim, Julian Hochberg, Hans Toch and Malcolm MacLean, and Franklin Fearing.

70. Otto, Wayne and Gwenyth Britton. Sense-Impression Responses to Verbal and Pictorial Stimuli. Eugene, Oregon: University of Oregon and Portland Public Schools, Feb., 1964. (Paper given at the annual meeting of AERA, Feb., 1964, Chicago, Illinois).

Using pictorial and verbal representations of 35 concrete nouns as alternate stimuli, the experimenters found that students in grades 8-10 gave more "sense-impression responses" to pictorial stimuli than to verbal, when asked to give free associations. The pictorial stimuli consisted of black and white line drawings. Responses were judged to be sensory when they fell in any of the 40 Underwood and Richardson categories. The indicated finding was significant at the .01 level.

71. Peirce, Charles Sanders. Collected Papers of Charles Sanders Peirce, Vol. II, Elements of Logic. (Edited by Charles Hartshorne and Paul Weiss) Cambridge: Harvard University Press, 1932.

This work is of interest, here, primarily because of Peirce's original discussion of the various types of signs--especially icons and indices. Peirce, apparently, was the first modern philosopher to define and discuss iconic signs, as such. Although Peirce classified signs, in various ways, into 10 (and later, into some 36) categories, he considered the three-fold division into icons, indices, and symbols to be the most fundamental. His nineteenth century discussion is still interesting and suggestive to investigators and theoretician who are concerned with the study of signs.

72. Piaget, Jean. Psychology of Intelligence. Patterson, New Jersey: Littlefield, Adams and Co., 1960.

As in his other works, Piaget deals with the various stages or levels of cognitive behavior--the relationship between sensori-motor and conceptual processes. At certain stages of development, errors in reasoning may result because perceptual data precipitate a pre-logical or incomplete intellectual construction. In a sense, the child is incapable of formal logical thinking because his thought is bound to a sensori-motor framework. Still the formal operations of the mature intellect "could not have any mental meaning, were it not for the concrete operations that both pave the way for it and provide the content."

In a critique of "thought psychology" Piaget denies that the image is a constituent element of thought. Thought is an act --not, presumably, a mere succession of mental images." Images accompany thought and serve as symbols for it, but they do not constitute the intelligent act of judgment."

73. Ratliff, Floyd. "Inhibitory Interaction and the Detection and Enhancement of Contours," Sensory Communication. (Contributions to the Symposium on Principles of Sensory Communication, Massachusetts Institute of Technology, 1959. Edited by W. A. Rosenblith) New York: M.I.T. Press and John Wiley and Sons, 1961.

The discharge of inhibitory interaction among neural elements on their patterns of activity as studied in the eye of the Limulus (horseshoe crab). "The discharge of impulses in any one optic nerve fiber depends not only upon the stimulus to the specific receptor unit from which that fiber arises but also upon the spatial and temporal distribution of the stimulation of the entire population of interacting elements. These interactions accentuate contrast at sharp spatial and temporal gradients and discontinuities in the retinal image: borders and contours become 'crisp' in their neural representation. Thus, the pattern of optic-nerve activity that results is by no means a direct copy of the pattern of stimulation on the receptor mosaic; certain information of specific significance to the organism is accentuated at the expense of less significant information."

74. Read, Herbert. Icon and Idea. New York: Schocken Books, 1965.

The theme of this collection of lectures, delivered at Harvard University, is suggested by the sub-title: "The Function of Art in the Development of Human Consciousness." In a variety of ways, Read develops the thesis that "what has not first been created by the artist is unthinkable by the philosopher." Art is not just a way of expressing ideas or embellishing reality. The artist has the practical function of actually creating reality through images. "Before the word was the image, and the first recorded attempt of man to define the real are pictorial attempts--" In modern culture, a cleavage exists between our "mechanical and materialistic" civilization and aesthetic values. But art continues to be a vital activity which serves to bring inarticulate perceptions into consciousness, and thus creatively renews the stream of human consciousness.

75. Ruesch, Jurgen, and Weldon Kees. Nonverbal Communication: Notes on the Visual Perception of Human Relations. Berkeley: University of California Press, 1959.

Deals with the role of nonverbal signs and symbols in human behavior, with emphasis upon the "visual perception of human relations." Pictorial signs, art forms, actions, expressive movements, posture, appearance, and clothing are among the various types of nonverbal "languages" which may be useful for deliberate as well as non-intentional communication. The authors express the view that educational, occupational, and other spheres of behavior are geared to the verbal capacities of the individual--that nonverbal sources of information, although constantly present, are largely ignored and not given sufficient weight or emphasis in the practice and study of communication. The isolation of any particular aspect of communication is likely to be misleading. Hence, the realm of the nonverbal requires attention and investigation to bring knowledge and skills in this area abreast of verbal communication. Photographic illustrations are used to show many nonverbal ways in which people reveal their inter-personal relationships and social roles; structure community activities; display personality traits; or give evidence of disease.

76. Saul, Ezra V. and Agnes M. Rockett. "The Effect of Selected Spatial Design Factors in Educational Displays on Learning and Retention." (NDEA Title VII Project no. 694) Washington, D. C.: U. S. Office of Education, June 1964.

This study poses a problem that has received relatively little attention: What is the effect upon learning of varied spatial arrangements of labels in a visual display? In this experiment it was found that the spacial arrangement of labels, as the experimental variable, produced no significant differences in learning and retention when films and lecture were used to teach groups of high school students the anatomical parts of the body.

77. Smith, Karl U. "The Scientific Principles of Textbook Design and Illustration," AV Communication Review 8:27-49; Winter, 1960.

Creative art in books assists the reader by (1) providing perceptual motivation, (2) perceptually reinforcing what is read "so that situations, events, and relationships described in words are made more meaninful and thus are better retained," and (3) by providing symbolical enhancement which "deepens the meaning of the verbal material and thus serves to advance the organization of the verbal materials to promote creative thinking." Smith argues that integrated artistic illustration of textbooks demands that the book be written from the outset "around illustrations," and that communication between the author and the artist requires non-verbal communication which is accomplished through the use of preliminary drawings prepared by the author. He allows that verbal memory and comprehension are not increased "on a short-term basis" by artistic illustration but predicts that their use will enhance "perceptual memory" of the contents of a book. The same principles proffered for the illustration of textbooks are described as applicable to other educational media.

78. Smith, Sidney L. and Donald W. Thomas. "Color Versus Shape Coding in Information Displays." Journal of

Applied Psychology 48:137-146; June, 1964.

When confronted with a randomly arranged display of objects (projected upon a screen) the subjects in this experiment counted more rapidly and more accurately when the counting was based on a five-value color code than when it was based upon any of three shape codes. In other words, the subjects were able to discriminate more readily among colors than among shapes. Shape counting was somewhat faster and/or more accurate when color did not vary on the display, and vice versa.

79. Smith, William Hickman. "Visual Analogy in Nonverbal Communications." Doctoral Dissertation, School of Education, Indiana University, 1964. Mimeographed.

This doctoral study is concerned with the effect of pictorial symbolization, based upon principles of analogical codification. The author grants that communication involving highly abstract and some other kinds of referent categories "will always evade the confines of a neat, simple, pictorial symbol system." But he feels there is a highly promising potential in the analogical coding of messages and the extension of this strategy to situations where it is not commonly used at the present time. The experiment involved the use of a series of non-verbal traffic signals or messages, some of which were developed for international use under auspices of the United Nations, some by the author, himself, employing certain systematic rules of cue treatment of the symbol components. A selection of 27 symbols, were ranked by judges on a nine-point scale for "degree of iconicity," were employed in a test to determine what symbols would be interpreted correctly, how quickly correct responses would occur, the subjective certainty of responses, and appropriateness of interpretation of each symbol in terms of driver response. The hypothesis that scores on each of the four measures would show positive correlations, in each case, with the degree of iconicity of the symbol was confirmed by the testing procedure and analysis of results, using the product-moment correlational method recommended by Koenker.

80. Steiner, George. "The Retreat from the Word." Kenyon Review 23:187-216; Spring, 1961.

Western civilization has an essentially verbal character due to its Greek-Judaic inheritance. We take this character for granted. As Steiner puts it, we live inside the act of discourse. However, this belief in the primacy of the word and the possibility of containing all human experience within the bounds of discourse is no longer universal. In mathematics, philosophy, and art, Steiner detects a "retreat from the word." Despite the common assumption that humanistic authority, the sphere of the word, is still predominant, there is now another culture not based primarily upon the word, as C. P. Snow has pointed out. Steiner cautions that "we should not assume that a verbal matrix is the only one in which the articulations and conduct of the mind are conceivable. There are modes of intellectual and sensuous reality founded not on language but on other communicative energies such as the icon or the musical note."

81. Stolurow, Lawrence M. and Henry Lippert. "Prompting, Confirmation and Vanishing in the Teaching of a Sight Vocabulary." (U. S. Office of Education, Cooperative Research Project, Contract No. SAE 8370) Urbana Illinois: University of Illinois, Institute for Research on Exceptional Children, 1962.

This study explored the effects of a vanishing procedure by which a combination of prompting and confirmation techniques were used to teach a sight vocabulary to educable mentally retarded children. It was suggested by earlier research in programed instruction in which the investigators found that prompting sequences produced more rapid learning, but that confirmation was more effective for retention when a high degree of overlearning was used.

Although analogical signs were not involved in this study as an experimental variable, in their own right, pictorial symbols were used as eliciting stimuli. This investigation is included in the bibliography as only one example of an indeterminate but very large number of psychological and educational research studies which are similar in the respect just noted. No doubt some of them, possibly many, contain reflected or indirect information of interest to the users of this bibliography, since they involve at least implicit assumptions about the possible functions of iconic signs in communication and teaching. Here is an immense field which may warrant some probing, but which lies beyond the scope of this bibliographical search.

This study can be cited as an example of the many which involve the use of iconic signs, in some way, but not as an experimental variable.

82. Toch, Hans and Malcolm S. MacLean, Jr. "Perception, Communication and Education Research: A Transactional View." AV Communication Review 10:55-77; September-October, 1962.

This is a relatively recent review of transactional theory as applied to perception and audiovisual communication. The authors trace the implications of the view that perception is an integral part of a more inclusive behavioral context. With respect to research, the authors warn that an excessive concern for purifying and controlling may lead the experimenters to "squeeze so much of the life blood out of the situation that the results provide us little help in dealing with our real-life worlds."

83. Travers, Robert M. W. (editor). Research and Theory Related to Audiovisual Information Transmission. U. S. Office of Education Contract No. 3-20-003, Interim Report.) University of Utah: Bureau of Educational Research, 1964.

Drawing upon the literature of experimental psychology, Travers and his associates have constructed a theoretical model for the transmission of information by audiovisual materials. The orientation stresses information theory as applied to psychological research--the work of Broadbent in particular. Essentially, the proposed theory is a close adaption of Broadbent's model of the human information processing system which features the notion of a limited capacity channel ("P system") fed through a selective filter from a short-term storage reservoir of sensory inputs--a concept which is fully described in Broadbent's 1958 publication, Perception and Communication, (Pergamon Press). Travers' adaption provides for a "compression" stage as information enters at the receptors, and for some elaboration of the processes presumably subsumed under Broadbent's "selective filter." The central idea is that of a single-ohanel data utilization system which passes only one message at a time. Thus, in tracing the implications of his model for the use of audiovisual materials, Travers is particularly critical of the notion that multimedia presentations increase learning by virtue of the plurality of media involved. He holds that exactly the opposite effect may result when too much information is presented through two (or more) channels simultaneously, unless the density of information and rate of presentation is sufficiently low to compensate for the overloading and selective filtering by which relevant information may be lost.

In addition to what he considers to be the multimedia "reinforcement" fallacy, Travers is critical also of the notion that audiovisual material produce significant results by virtue of a special non-linguistic language of communication, as well as the related idea that AV materials have a high value for "relating the learner to reality." While nonlinguistic learning can occur, it is of an inferior grade, whereas useful learning at the human level typically involves linguistic coding. Similarly, emphasis on realism, as such, is the "worship of a false god." The intelligent use of information by human receivers is a highly selective process which may be impeded by the presentation of realistic and irrelevant detail.

84. VanderMeer, A. W. "Color vs. Black and White in Instructional Films." AV Communication Review 2: 121-134; Spring, 1954.

This well known study is included in the bibliography mainly as a reminder of this interesting but still relatively unexplored dimension of the problem of iconic signs. VanderMeer's finding was that color seems to make little difference in learning from films, although it may help to improve retention. Other studies have produced somewhat varying results . By and large, the various theoretical discussions dealing with iconic signs have paid very little attention to color, thus far.

85. VanderMeer, A. W. and Howard E. Thorne. "An Investigation of the Improvement of Educational Filmstrips and a Derivation of Principles Relating to the Effectiveness of these Media. Phases I and II, Revision of Filmstrip--The Sun and Its Planets." (NDEA Title VII Project 224) Washington D. C.: U. S. Office of Education, 1962.

These two studies involved two successive revisions of a filmstrip to determine whether changes developed by a team consisting of the investigators, the producer, the producer's educational consultant, and the filmstrip artist would improve the effectiveness of the filmstrip as measured by a multiple-choice test. A sample population was composed of students from four different grade levels (5,6,7,10) and split into two randomly constituted halves. With the exception of the tenth grade group, students who saw the second revision (and not the original filmstrip) earned mean scores significantly higher than those for the students who saw only the original filmstrip. This difference was not demonstrated in phase I when a different group of students was tested on the first revision. Evaluation of revisions, frame-by-frame, revealed that out of 35 frames which were changed in the second revision, 21 produced significant differences in learner responses in favor of the revised frames. Obviously, not all the changes in individual frames were uniformly successful; also the results varied from one grade level to another. Commenting on types of changes that seemed to improve individual frames, the investigators mentioned the addition of labels and/or attention directing arrows and the organization of randomly presented non-verbal material into tabular form, and the rearrangement of progressions of labelled objects or sequences of events so as to read from left to right or from top to bottom--with regard to pictorial elements. Captions were improved by capitalizing or underlining key words or phrases, eliminating irrelevant content, and adding attention-direct ting questions or statements. (Increasing the iconicity of some frames was not as successful in this case as it was in the "phase III" study involving the revision of another filmstrip.)

86. VanderMeer, A. W. and Robert Montgomery. "An Investigation of Improvement of Educational Filmstrips and a Derivation of Principles Relating to the Effectiveness of These Media. Phase III, Revision of Filmstrip--Earth's Satellite." (NDEA Title VII Project no. 224) Washington, D. C.: U. S. Office of Education, 1962.

This study explored a systematic method for revising an educational filmstrip in order to produce better instructional results. After identifying relatively ineffective frames by a preliminary test, the investigators, in collaboration with the producers, the educational consultant employed by the producers, and the filmstrip artist analyzed both the pictorial and verbal elements of the weak frames and developed specifications for changes in the pictures and/or captions, in each case. As a result, 31 frames were changed. The original and revised versions of the filmstrip were shown to two randomly constituted halves of the total sample population of students. One group saw only the original version; the other saw only the revised version. Statistical analysis of test scores revealed that the revised version produced significantly higher mean scores for both junior and senior high school students. Mean scores for two groups of fifth grade students were not significantly different. Among the total group of students who saw the revised filmstrip a significantly higher proportion made correct responses to 23 out of the 79 items in the test. Although the total instructional result was beneficial, the effects of changes in specific frames of the filmstrip varied somewhat with the grade levels of the students. A relatively small number of revisions of individual frames produced negative results at one grade level or another. Summarizing the types of changes that proved most successful, the investigators stressed increased "iconicity," additional redundant cues, and more directional arrows, for pictures; increased redundancy, "stronger" wording, and increased succinctness, for verbal captions.

This, and the preceding studies in this series, illustrates both the importance of making this kind of empirical experimentation with visual-verbal presentations, and also the need of theoretical development and the difficulty of making reliable intuitive judgments about visual communication, even when expert and experienced persons pool their efforts.

87. von Senden, M. Space and Sight. London: Methuen & Co., 1960. (Copyright, 1932).

Published in 1960, this volume makes available to English readers for the first time a valuable collection of case reports on the perception of space and shape by congenitally blind patients, before and after operation. Von Senden's material, which includes a good deal of his own interpretation of the reports, deals mainly with two questions: (1) Does the congenitally blind person develop a "sense" or consciousness of "tactual space"? (2) How does spatial consciousness develop in the congenitally blind after sight has been restored? He finds no satisfactory evidence that the person who is blind from birth builds up something that could be called a "tactual space." Instead, he argues that orientation is achieved through learned patterns or sequences of tactile and kinaesthetic behavior, so that spatial problems are resolved on a temporal basis, so to speak. After restoration of sight, the patient must literally learn to see, and this is typically a rather lengthy process--one at which some patients fail. Most patients are conscious of some visual stimulation from the start, usually rather vague patches of color, and usually with some sense of depth, distance, or separation from the patient. They rely heavily upon tactual and manipulative cues to help them identify visual objects, especially in the early stages of learning to see, but at some stage the visual mode "takes over."

and becomes the dominant sense. Reactions to von Senden's interpretations are bound to vary with the psychological and philosophical predilections of the reader, but no one can fail to be impressed by the importance and interest of the data he has assembled.

88. Vygotsky, Lev Semenovich. Thought and Language. (Translated by Eugenia Hanfmann and Gertrude Vakar) Boston: M.I.T. Press, 1962.

Vygotsky relates his experimental work on the forming of concepts to a theory of intellectual development involving the related through genetically distinct functions of thought and speech. The development of conceptual thinking proceeds through a series of stages from the vague syncretic conglomerations of objects which constitute the first "categories" of child thinking, through "complex" thinking and "pseudo-concepts" to the true conceptual thinking that gradually unfolds and deepens during the period of adolescence.

Scientific concepts are not taught through a process of sheer exposition and assimilation. They have an "inward history." The concept is an act of thought which can be accomplished only when the child's mental development has reached the requisite level. However, teaching does benefit intellectual growth, which has an organic unity. All the basic school subjects act as a formal discipline, each facilitating the learning of the other. Scientific concepts, which are generally taught, grow downwards; spontaneous concepts which arise out of the childs every day experience grow upwards; and each benefits the other.

Word meanings, or concepts, are dynamic formations which evolve and develop. The relation of thought to word is a process. The relationship between the two is partly revealed by the two planes of speech: inner, semantic speech, and external phonetic speech. Internal speech in the adult is a continuation of the egocentric speech of childhood, or rather, the one is a developmental stage preceding the other. In the adult, the distance between inner speech and phonetic speech gradually increases. Thinking arises at the level of internal speech where "words die as they bring forth though," but thought finds its reality and form in speech. The relationship is described as continual movement back and forth from thought to word and from word to thought.

Behind every thought there is an affective-volitional tendency. Actions precede words, genetically speaking, but the meaningful word is "the end of development, crowing the deed." "Thought and language, which reflect reality in a way different from that of perception, are the key to the nature of human consciousness. Words play a central part not only in the development of thought but in the historical growth of consciousness as a whole. A word is a microcosm of human consciousness."

89. Williams, J. C. and S. N. Roscoe, "Evaluation of Aircraft Instrument Displays for Use with the Omni-Directional Radio Range (VOR)." Journal of Applied Psychology 34:123-130; April, 1950

This study was concerned with the question of the most useful display of information provided to an airplane pilot from the omni-directional radio range, a device that makes it possible to fly to a station along any desired track, or from a station in any desired direction. Dependent variables were the speed and accuracy with which a pilot could use the displayed information.

A comparison was made using eight different displays, five of conventional design and three pictorial. The subject, in each case was given a series of navigational problems to solve. Regardless of the type of pilot (experience) all did better and faster using pictorial displays. The best pictorial display was centered on the station with the aircraft represented by a moving blip (rather than the reverse.)

The test was considered to be reliable because it was consistant from group to group. Also, the test showed internal consistency.

The experiment should not be generalized to flight conditions. The symbolic instruments provide more sensitive information in some respects but the information must be interpreted, i.e., the pilot must make an inference to a decision.

90. Zuckerman, John V. "Commentary Variations: Level of Verbalization, Personal Reference, and Phase Relations in Instructional Films on Perceptual-Motor Tasks." (Technical Report SDC 269-7-4, for the Special Devices Center) Instructional Film Research Program, Pennsylvania State College, 1949.

This study explored the effect of certain variations in sound verbal commentary, in an instructional motion picture on knot-tying, upon actual task performance. Among other things, it was found that a medium level of verbal commentary produced the best results--also that a commentary "leading" the picture was better than one "lagging" behind it.